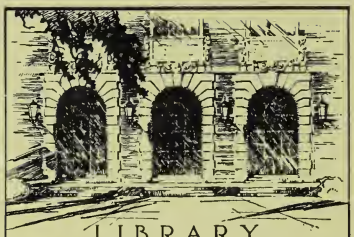
# Theatre Construction and Maintenance

James Geo. Buckle, A.R.I.B.A.

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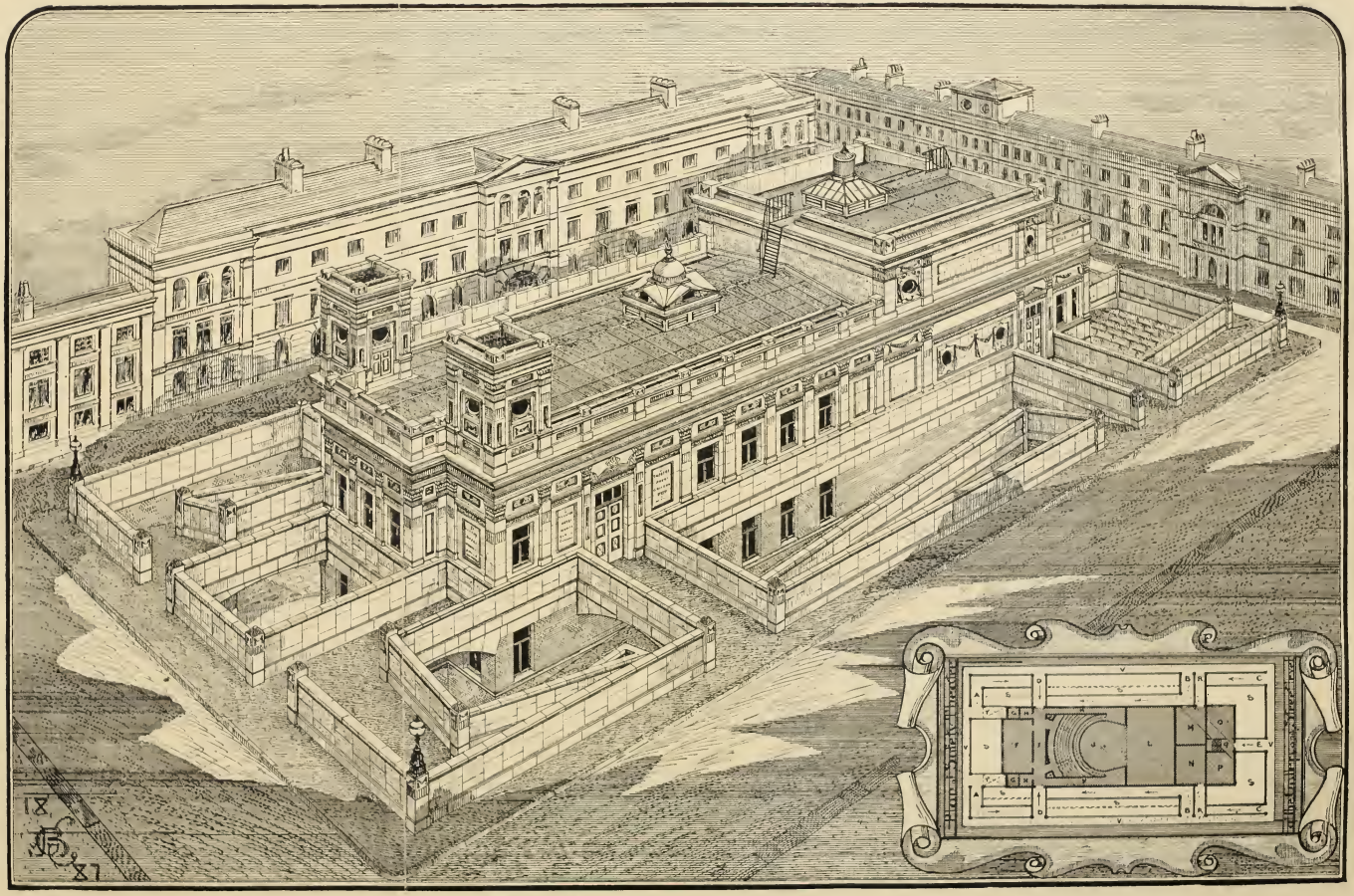

# A Safety Theatre.

(FOR DESCRIPTION, SEE PAGE 134.)

# THEATRE CONSTRUCTION AND MAINTENANCE:

*A Compendium of useful Hints and Suggestions on the subjects of Planning, Construction, Lighting, Fire Prevention, and the general Structural Arrangements of a Model Theatre;*

INCLUDING

*The Regulations prepared by the Metropolitan Board of Works and the Lord Chamberlain;*

TOGETHER WITH

## A MODEL SET OF RULES,

BASED UPON

THE METROPOLITAN, PROVINCIAL, AMERICAN, AND CONTINENTAL THEATRE REGULATIONS.

BY

J. G. BUCKLE, A.R.I.B.A.

Play-houses are more necessary in a well-governed commonwealth than schools, for men are better taught by example than precept.'—SIR T. OVERBURY.

London:
"THE STAGE" OFFICE,
CLEMENT'S HOUSE, CLEMENT'S INN PASSAGE, STRAND, W.C.
1888.

TO

WILSON BARRETT, Esq.,

A MANAGER WHO HAS DISPLAYED AN EARNEST DESIRE TO ADOPT REFORMS CONDUCIVE TO THE PUBLIC SAFETY AND CONVENIENCE, THE FOLLOWING PAGES ARE, BY KIND PERMISSION, INSCRIBED.

# PREFACE.

*In the preparation of the following pages the Author does not claim to have produced a work wholly original. The writings of contemporaries and others have been consulted, and their suggestions adopted when cognate to the subject of this work. Suggestions and opinions which the Author may claim as his own are based upon observations made during a critical survey of the London theatres.*

*It has not been sought to produce a technical treatise on theatre-building, suitable only for professional experts, but rather a comprehensive series of suggestions touching upon the multifarious structural requirements of a modern theatre.*

*As a book of reference, it is hoped the present volume may be found serviceable to architects, theatre managers, licensing magistrates, local authorities, and others having the supervision or control of public buildings.*

*With this object the Author has endeavoured to keep steadily in view the three primary conditions essential to a satisfactory theatre—*

*1. That the building should be adapted for the* business *of a theatre.*

*2. That the building should be suitable in every essential for the reception of the public.*

*3. That the building, together with its contents, should be practically fire-resisting.*

*Captain Shaw, C.B., in his* brochure *entitled "Fires in Theatres," observes that "it is possible, without interfering with any of the legitimate purposes for which theatres are constructed and maintained, to ensure the absolute safety of an audience, and the partial safety of a building and property, in the event of fire."*

*A theatre should not only be fire-resisting, but* panic-proof.

*To this end the building should have every structural convenience and appliance necessary to combat—and, if possible, avert—those evils which in the public estimation are inseparable from such buildings.*

*Wide staircases, spacious crush-rooms, polished hydrants, suspended buckets, and real firemen will avail but little, should a panic arise, unless the audience has been impressed with a* feeling of security. *The first essential towards creating this confidence in an audience is that the manager, together with his employés, should themselves experience this* feeling of security.

*The hygienic condition of public buildings is a matter to which but little consideration is devoted either by architects or the authorities. Efficient ventilation is ignored, and patrons of the drama are compelled to sit for hours in a stifling atmosphere, inhaling the fumes from gas, and re-breathing the exhalations from many lungs. Yet, these evils could be rectified for an outlay not exceeding five shillings per sitting. Overcrowding—or, in other words, wilfully endangering the safety of the audience—is practised by many who certainly do not take to heart the observation of a well-known manager, who asserts that "no manager ought to invite a visitor to the play without offering him, as near as possible, the same comforts that he leaves at home."*

*The systematic supervision of theatres by the State is probably only a question of time. A perusal of the following pages will afford an insight into the complex arrangements of modern theatres, without which knowledge, acquired either by reading or personal observation, neither legislation, supervision, nor control can be satisfactorily accomplished.*

*J. G. B.*

LONDON, 1887.

# THEATRE CONSTRUCTION AND MAINTENANCE.

## INTRODUCTION.

THE architect who may be desirous of introducing reforms or improvements in the arrangement or construction of theatres, will have to combat with the conservative prejudices of theatrical managers.

Before proceeding to detail the numerous requirements of a modern theatre, there are a few matters to which allusion must be made, the most important of which is the selection of a suitable site. A perfect site should be isolated: isolation implies convenience and safety. Ten feet is the least distance that should separate a theatre from contiguous buildings, and where this cannot be accomplished a corner site should be secured. Sites for theatres are not easily obtained. There exists a very prevalent antipathy to theatres as a medium for speculation. Such buildings are by some supposed to depreciate the value of adjacent property. In general this is mere prejudice, although owners of property in the immediate vicinity of a theatre pay higher insurance rates for the privilege of having so dangerous a neighbour. A good site should have one frontage to a principal thoroughfare. This will increase the cost of the building, but will enhance the popularity of the theatre. A sloping site is preferable to a level one, if the decline is towards the stage, in which case the building may be so disposed as to save expenditure in excavation and staircases, whilst bringing the occupants of the upper parts of the theatre nearer their respective exits. Before fixing upon a site, it is desirable to ascertain the depth of the main sewer, the position

of which will materially affect the disposition of the building. The stage cellar generally requires draining ; this, if overlooked, may involve permanent expense for pumps or contrivances to keep out the water.

It does not come within the scope of this work to enter upon a disquisition as to the style of architecture or decoration most suitable for theatres, as these are matters best left to the individual taste of the architect. It is probable, however, that no other secular building—by reason of its purpose and associations—so readily lends itself to refined architectural treatment and artistic decoration. A cheerful and inviting façade will help to fill the managerial coffers. The embellishments of a theatre should indicate not only a Temple of the Drama, but of Poetry, Music, and Painting. What would be regarded as "showy" and "tawdry" in any other building is frequently the only Art (?) to be found within a theatre—glare and tinsel. Hence "theatrical," as applied to decoration, has become an epithet of condemnation and reproach. The auditorium decorations should be effective, yet subdued. When too pronounced and obtrusive, the "stage picture" will suffer by contrast. In many theatres there exists room for considerable improvement in the general arrangement and decoration of the proscenium frame. This should never be so treated as to destroy the appearance of a frame to the living picture beyond. Solid gilt has hitherto been regarded as the most approved method of decorating the proscenium frame, although, as the effect of some pictures is highly enhanced by the introduction of a line of colour between the gold frame and the subject, so with the stage picture an inner frame covered with black or coloured velvet would at times enhance the effectiveness of the scenic display.

Another matter calling for improvement is the modern "act-drop," which is invariably inappropriate. It discloses the scene in the least desirable manner. The actors are discovered legs first, and decapitated at the first descent. An "act-drop" is a substitute for a curtain, and should be so treated when decorated. Neither landscapes, men, nor animals are admissible for the purposes of decoration, when these have to be *rolled up*. Conventionally treated the act-drop offers an opportunity for high-class artistic work, yet seldom is an effort made to design it in harmony with the auditorium decorations.

For the gradual, pleasing, and artistic development of the stage

picture, "tableau curtains" are undoubtedly the most desirable. These, when made with rich material, harmonising in colour with the auditorium decorations, add considerably to the effectiveness of the interior.

Every part of a theatre should be arranged with the utmost compactness; this will decrease the working expenses, and secure the commendation of the management. Each new tenant of a theatre quickly discovers the defects in construction and arrangement, with the result that the blessings pronounced upon the architect are few and far between. When planning the several sections, it is desirable to arrange the foyer, saloons, cloak-rooms, and sanitary offices outside the retaining walls of the auditorium.

In the near future, theatres will probably be licensed to accommodate certain numbers, as is now the case with steamships and omnibuses. Such a reform in this country must be the outcome of legislation. Managers—however commendable their efforts—are unable to withstand the temptation to pack their houses. When calculating the money-holding capacity of a proposed building, the following dimensions will be found to constitute a fair average width of seat per individual—stalls, 20 to 24 inches; dress circle, 20 to 22 inches; upper circle, 18 to 20 inches; pit, 16 to 18 inches; amphitheatre, 16 inches; gallery, 15 inches. In addition to the actual seating, allowance must be made for the standing-room. Standing is most undesirable, but when permitted, should not exceed one single row at the back of each circle or section of seating. Overpacking an audience engenders several evils—discomfort, insufficient ventilation, congested exits, and the risks inseparable from panic intensified.

With respect to the general management of a theatre, too much stress cannot be placed upon the real necessity for instituting FIRE AND PANIC DRILLS.

The attendants in a theatre, if they are to be of service on an emergency, must be periodically instructed, not only in the use of the fire-extinguishing appliances, but as to their exact duties in the event of panic. Managers will, at times, put a nonentity into a uniform, and call him a fireman, yet, whilst acknowledging the value of a uniform, fail to provide a distinguishing dress or badge for the attendants. The public respect a man in uniform, be he a policeman, commissionaire, or fireman, either of whom

would exercise more authority and inspire greater confidence than a gesticulating waiter in a white cravat.

To successfully design a theatre, a general knowledge of the internal working of such buildings must be first acquired. "*A place for everything, and everything in its place*," will be found a good guiding principle. The architect should not hesitate to consult with the representative of each department; from that of the business manager, who requires his rooms conveniently situated for the quick discharge of his duties and easy supervision, down to the prompter, who would like a small room for "hand properties" close to the stage.

Manager and architect should carefully examine the plans, and see that all reasonable requirements have been provided for the convenience of the public and the satisfactory working of the theatre. A few hours devoted to this purpose will avoid subsequent alterations, dissatisfaction, and "builder's extras." The grand principle that should govern the disposition of the plans is the provision of fire-resisting structural divisions between the auditorium, entrances, and staircases; public rooms, managerial offices, stage, workshops, property stores, and dressing-rooms. Where practicable, these divisional walls should be carried up through the roofs. In the case of the proscenium wall this is imperative. All the roofs should, without exception, be constructed as flats, and connected with iron ladders, to enable the firemen to get quickly from one point to another.

The auditorium should be cosy and *not too large*. In large theatres, which are not desirable for dramatic representations, some of the auditors are removed so far from the stage that the performers are almost inaudible and their facial expression entirely lost.

All windows in open areas overlooking other sections of the building should be protected by stout iron netting, fixed to the brickwork, and overlapping the openings at least three inches all round. Windows facing the street do not require to be so protected. Windows that are within easy reach of the ground should be fitted with casements hung to open outwards, as a means of escape in the event of fire or panic.

The upholstering of a theatre calls for the exercise of taste in the selection of the materials and colours. The beauty of an interior may be greatly enhanced or miserably marred by the

upholstery. For this reason theatre decorators are occasionally permitted to carry out the upholstering with the view to securing a harmonious combination.

Apart from the artistic question, too much upholstery in a theatre must be regarded with suspicion. It cannot be recommended on the grounds of comfort, safety, or hygienic suitability. Cocoanut matting, often used in gangways to deaden the sound, is both inflammable and filthy. A wood-block floor is preferable. Where appearance has to be studied, the best linoleum should be used. This latter material is well suited for saloons and smoking-rooms: *it can be washed.* Custom demands carpets, but these are not essential to comfort or elegance. They harbour dirt, and are bad conductors. Never hang fringes or valances to the soffits of the circles. These collect the dust, interfere with the sight, and intercept the sound-waves.

Stuffed seats are not to be recommended. They are uncomfortably warm, and harbour the dust. Some descriptions of American chairs, having bent-wood seats, are comfortable in winter and cool in summer. Always use "tip-up" seats. Those are the most desirable that permit the arm-rests to fold up with the seat. "Tip-up" seats having fixed arm-rests are of little use for the purpose of increasing the width of the exit thoroughfare.

It is imperative that a theatre should be cleaned down each day. In order to maintain a clean and healthy building, all finishings and decorations to walls should be washable, and carpets should not be nailed to the floor, so that they may be frequently shaken. Carpets necessitate brooms, which, in the hands of a cleaner, are merely instruments for raising a dust. Rose-cans, tea-leaves, or damp sawdust are unknown to theatre-cleaners. The floors and corridors should be covered with linoleum; and if carpets must be used, let these be mere strips.

Rely for cleanliness on soap and water. Washing the floor cools the air, without charging it with dust and other impurities. Cleaners should be provided with approved lamps—never with candles—and these should be trimmed each day with the *best* quality of oil.

It is desirable that the most remote spectator should not be more than seventy-five feet from the stage, nor the angle of vision exceed forty-five degrees. Neither manager nor architect should sanction a seat being fixed unless it permits a good view of the

performance. Having regard to the convenience and adaptability for dramatic representations, the following accommodation cannot probably be much exceeded: Stalls, 200; pit, 600; first circle, 250; second circle, 350; amphitheatre, 100; gallery, 500: total, 2000.

It is imperative that a theatre claiming to be designed upon the most approved plan should be lighted by means of windows in every part. The auditorium and its adjuncts; the stage, scene docks, stores, workshops, cellars, wardrobes, and, indeed, every room within a theatre, should be efficiently lighted. This will conduce to ventilation, cleanliness, and economy in the consumption of gas.

Having enumerated a few of the minor necessities of theatre construction which should be kept in mind during the preparation of the plans, I will proceed to describe in detail all the various requirements essential to the production of a modern *self-contained* theatre, in which all the operations incidental to the business are duly provided for.

### External Porticos.

These should communicate with an inner vestibule of at least equal size and importance. The entrance, while inviting the visitor, should not excite expectations that are harshly dispelled by the cramped meanness of the interior halls and approaches. Vestibules have been described as "the curse of all theatres," on the ground that in the event of a panic they constitute a meeting-point for large numbers of the audience. Having regard to comfort, they are of real value, and their disuse would not be favoured by the patrons of the better parts of the theatre. In addition to the outer vestibule, or portico, an inner vestibule should be provided, sufficiently large to constitute a crush-room capable of accommodating the whole of the dress portion of the audience.

### Entrances and Exits.

These are all-important. The safety of an audience depends more upon judiciously arranged means of egress than upon any precautionary system of fire appliances or fire-resisting construction. Panic may develop itself at any moment, without adequate cause. False alarms and imaginary fears may be productive of a more serious panic than the presence of real danger. There should be means of escape from the building sufficient to withstand

the sudden and extraordinary pressure of a stampede without the exits becoming congested. With this view, at least two means of egress from each section of the auditorium, leading direct into the street, should be provided. Let the means of egress be clearly indicated by *permanent inscriptions* on the doors or walls, together with the names of the streets into which the exits lead. Do not use placards nor framed notices; these may become detached. All exits should be used nightly, and the words "Emergency door" or "For use in case of fire" should *never* be written upon a door. Never permit an audience the choice of familiar and unfamiliar ways. The hesitancy they produce causes confusion and destruction. An attendant wearing a distinctive badge or dress should be placed in charge of each exit-door.

### External Doors.

These should never be of less width than 4 ft. 6 in., hung in two folds, and made to open both *outwards* and *inwards*. This latter arrangement would avoid confusion when crowds are waiting outside, at which times panic is possible from pushing and scrambling for entrance.

Where practicable, there should be allowed 1 ft. in width of door-space to each fifty persons, and never less than 1 ft. for each 100 persons; *e.g.*, 1000 persons should have a *minimum* width of exit passage equal to 10 ft. This may be in two passages, each 5 ft. in width. The door-space allowed for exit in the best-appointed London theatres averages about 1 ft. for each sixty persons, and the rate of egress on ordinary occasions is about 400 persons per minute. It is undesirable to fasten external doors during the performance, but when this is done only such bolts should be used as can be easily forced by pressure from within.

At the Egyptian Hall and the Lyceum Theatre, London, a bolt has been fitted to the exit-doors which fulfils all the requirements of a panic-bolt, and the same principle may be applied to locks. The bolts are held in position by a spring, and cannot be forced from without, but pressure applied to the door from within immediately releases the bolt. With these bolts a Sunderland disaster would be impossible. Messrs. Chubb and Sons have produced a new door-lock for external exit-doors from theatres and public buildings. The lock is contained in a panel which occupies a large surface on the inside of the door, and any one coming into

contact with the door must press the panel, thus causing the door to open instantly. It is impossible for the officials of a building to lock or fasten the door so as to prevent egress at any time. From the inside it is always possible to get out, while from the outside it is impossible for any one to get in without the proper key.

### Verandah Covers.

Entrances should be protected from the weather by iron and glass verandah-covers ; the absence of these will affect the "takings" on wet nights. These covers are frequently fixed without means for carrying off the water. Dripping eaves are a greater annoyance to the waiting public than a shower of rain.

### The Queue.

French audiences are better drilled than English theatre-goers. The system adopted in France, whereby the people are admitted in single file, and entrance effected with decorum, does not find favour with either English managers or the public. This desirable arrangement is adopted at the pit entrance of the Savoy Theatre, London, and a well-arranged system of queues is in use at the Grand Theatre, Leeds.

### Staircases.

The staircases should be as near as practicable to the point of exit, without intervening passages. Their arrangement will exercise the ingenuity of the designer, if safety, convenience, and economy are properly considered. Staircases should invariably be wider than the passages or corridors leading to them, the reason being that crowds move with less rapidity on the staircases than on the level. The steps should be formed with fire-resisting materials, and supported at both ends on brick or masonry walls. The most suitable stairs are those constructed with Portland cement concrete ; these are cheaper and more reliable as a fire-resisting material than natural stone.

No public staircase should be less than 4 feet 6 inches wide, and should have fixed at both sides stout hand-rails, firmly secured to the wall, and, where practicable, should be let into a chase, so as not to project into the staircase.

A centre hand-rail is desirable in staircases exceeding 6 ft. in width. The width of the tread should not be less than 11 in., nor

the height of the riser exceed 7 in. The London authorities have fixed the height of the riser at 6 in. In the absence of such restrictions, 7 in. is a rise much to be preferred in the popular parts of the theatre, in so far that it more closely approximates to the ordinary dwelling-house stairs, and hence is a rise to which the bulk of an audience are already accustomed.

An endeavour should be made to light all staircases by means of windows. This is conducive to safety, cleanliness, good ventilation, and a saving in the consumption of gas at *matinées*.

### External Staircases.

In some Continental cities the provision of external escape staircases is compulsory. Where the situation of the building will admit, iron balconies might be fixed at each floor level, and communicate with the street by means of iron stairs. These, however, if only intended for use in emergency, should be regarded with disfavour. Appliances that are provided for use at remote intervals are invariably found to be out of order, and fail to act when most needed.

In existing buildings, where the means of escape from the dressing-rooms, flies, &c., are defective, and where the nature of the building and its surroundings will not admit of improvement, the Parisian fire-escape, in the form of a canvas shoot, might with advantage be fitted to existing windows or other purposely made openings.

### Pay-Boxes.

These should be systematically studied, as part of the plans. Subsequent temporary arrangements, protruding into vestibules and across passages, are unsatisfactory, and at times positively dangerous. The pay-places are best when situated well within the building. This will permit covered standing-room for the public in the corridors intervening between the entrances and the pay-boxes. The pay-places should further be easily get-atable by the business manager, and this facility of supervision must be studiously provided for by the architect.

### Barriers.

It is a comparatively easy matter to plan all the pay-places with a queue arrangement, whereby the public may be admitted singly, without at the same time interfering with the means of exit.

Temporary barriers should never be found in a well-regulated theatre. These may at any time be the cause of a catastrophe, and wherever found are indicative of want of forethought on the part of the designer.

## Box Office.

This frequently has the appearance of being an afterthought. It is placed in any out-of-the-way corner, least likely to interfere with locomotion. A large amount of business is transacted at the box office; it should therefore be a room of reasonable size, lighted by a window, and well ventilated. This office should be situated within the principal vestibule, and it will be an advantage if it can be seen from the main thoroughfare. Telephonic communication with the principal libraries, hotels, and clubs is desirable, also speaking tubes to the manager's and treasurer's rooms. For this latter purpose the Empire (non-electric) Telephone is preferable to speaking tubes. A small lift from the box office to the business manager's rooms, for the transmission of letters, &c., left at the box office, will save running to and fro, and avoid interruptions when the manager is engaged.

## Public Rooms, &c.

The popularity of a theatre is considerably increased by due attention to elegance and *homely* comfort. To secure increased patronage, managers, when letting the bars in their theatres, should not also sell the "privilege" to dun the public for fees, worry them about their hats and cloaks, charge exorbitantly for programmes, and demand a high price for common civility.

All public rooms, and, indeed, every part of a theatre, should be lighted by windows. Absence of light is a calamity. Darkness and dirt are twin sisters. Rubbish-heaps accumulate wherever there is a dark corner. These are dangerous to the building, because inflammable—dangerous to health, because they contaminate the air.

The foyers, saloons, and retiring-rooms in the better sections of the theatre should be comfortably and handsomely, if not luxuriously appointed. The walls should be decorated with works of art, but not with "suggestive" pictures, even if these be by acknowledged masters.

## Carriage Waiting-Rooms.

Where the inner vestibule is of small dimensions it will be found an acquisition to provide a retiring-room off the main vestibule, where ladies and gentlemen may await their carriages without impeding the egress of the audience. A small room communicating with the external portico may be provided for the use of footmen and servants in waiting.

There is room for improvement in the present method of—to adopt a military simile — *incarriaging* and *decarriaging* the audience. Ladies in evening attire and thinly wrapped have now to stand exposed to the cold winds, waiting for their carriages. The following arrangement would facilitate *incarriaging*, and avoid confusion :—

The carriages as they set down at the theatre door should be numbered consecutively, and the number intimated to the coachman and occupants. The carriages would then take up a position in the order of their number, or, failing this, they could, when the numbers were called out by the theatre commissionaire, follow up in their proper order. By this arrangement members of the audience would have timely intimation of the approach of their carriage, and need not leave the inner vestibule or waiting-room until their carriage is within two or three yards of the door.

When members of the audience are leaving before the end of the performance, electrical communication might with advantage be provided from the dress parts of the theatre to the outer vestibule or servants' waiting-room, connected with an indicator showing the number of carriage required. On persons leaving the auditorium, the attendant requests the number of carriage ; he then touches a button, and the number is indicated in the servants' waiting room or outer portico ; the number is at once called out, and the carriage waiting by the time the owners reach the entrance.

## Foyer.

It is desirable to provide a grand foyer or saloon, common to the whole dress portion of the house. This is the "drawing-room" of the theatre, and neither trouble nor expense should be spared to render it an enjoyable lounge. Nothing should be omitted that will contribute to elegance, ease, and comfort, and nothing should be sanctioned that is repellent to good taste.

## Refreshment Rooms.

In connection with each section of the auditorium, refreshment saloons are required. These should be spacious, well-ventilated, and of attractive appearance.

## Beer-Cellars and Stores.

The necessary accommodation for the refreshment-caterer is seldom provided for in the plans. Arrangements are improvised a few days before the theatre is opened, when it is remembered that a theatre, in addition to being a Temple of the Drama, needs also refreshment bars. These bars are a considerable source of profit to the theatre manager, and are frequently let to a refreshment contractor at a rental that compels him to sell inferior articles at exorbitant prices. The public cheerfully pay fifty per cent. more for their refreshments within a theatre, but they grumble woefully at the quality retailed. It is within the power of managers to insist that wholesome beverages be supplied to their patrons. The intellectual appreciation of a play is not enhanced by the wholesale distribution of poisons during the *entr'acte.*

## Smoking Saloons.

Adjoining the foyer and refreshment rooms should be the smoking saloons. Smoking in other parts of the building should be prohibited, and the rule rigorously enforced. A lighted match, carelessly thrown down, has destroyed many buildings.

## Lavatories, Urinals, and Water-Closets.

Too much care cannot be bestowed upon the sanitary accommodation, which is usually very inadequate in theatres. These necessary adjuncts to a public building should not be made obtrusively conspicuous. A regard for common decency should exist within the walls of a theatre. Urinals may be entered from the smoking-rooms or, through an intervening passage, from the refreshment saloons. They should be well lighted and ventilated. In the construction of urinals it is desirable that materials of a non-absorbent nature should be used. The receptacles should be glazed, the divisions enamelled, and the floors covered with asphalte. The trough urinal possesses many advantages over the ordinary single urinal. There is a continuous body of water in the

trough, which is periodically flushed by a self-acting flushing cistern. Very few flushing cisterns are adapted for use in theatres, consequent on the noise accompanying their discharge. The "Peckham" Syphon Cistern, supplied by Mr. Milton Syer, 36, Rye Lane, Peckham, is well adapted for use in theatres, either in connection with urinals or water-closets. It is silent in action, and has no working parts to get out of order.

Urinals and water-closets are required for each section of the audience. The apparatus best adapted for a public building is undoubtedly that having the fewest working parts. For use in theatres, the fittings of Mr. George Jennings, sanitary engineer, Stangate, London, S.E., are to be highly recommended for the simplicity of their working parts and general efficiency. Particular mention may be made of the patent valve closet and trap in one piece of earthenware, and the several varieties of "pedestal vases," which latter are well adapted for use in the better parts of the theatre.

The "tip-up" lavatories, on iron standards, are desirable, by their cleanliness and economy, and the absence of chains or plugs, for adoption in dressing-rooms. Where space has to be economised the trough urinals, arranged on the triple plan, cannot well be improved upon. Whatever appliances are used, these should be properly trapped and ventilated by means of upcast shafts carried above the roof, and fitted with an efficient exhaust cowl. In connection with the urinals, lavatories are only necessary for the dress parts of the house.

### Ladies' Cloak-Rooms.

Many representative theatres are sadly deficient in retiring-room accommodation. When planning these rooms, due regard for the natural modesty of English ladies, and approaches arranged with some degree of privacy, so as not to render progress to and from glaringly observable, is advisable.

In addition to water-closets, a lavatory is desirable, and each room should be further fitted with a counter, having shelves below, and a sufficient number of cloak-pegs.

### Gentlemen's Cloak-Rooms.

These should be arranged near the entrance vestibule, but removed from the direct line of exit.

Cloak-rooms are most desirably situated when approached by passages leading off the main corridors. These passages may with advantage be divided longitudinally, the people passing up one side to the cloak-room, and returning down the other. By this means struggling and confusion are avoided, and those congregating at the cloak-rooms do not impede the egress of the audience.

With respect to the general sanitary efficiency of public buildings, a grave responsibility rests with those authorities who wilfully neglect to enforce provisions that are alone compatible with a building fit for the reception of the public. What the law does not enforce common sense and public decency demand.

## Accident Room.

The regulations pertaining to some Continental theatres require that a special room shall be set apart for use in case of illness or accident, and the attendance of a medical man at each performance is compulsory.

Such requirements have not been found necessary in English theatres, although the attendance of a doctor is deemed advisable at each performance of the Paris Hippodrome at Olympia. A room, whilst devoted to other purposes, could at the same time be fitted with such appliances as would most probably prove useful in the event of illness or accident. An audience could seldom muster without including at least one member of the medical profession, and it is creditable to English doctors that they always respond to the call of duty or the cry of suffering humanity.

## Auditorium.

### *Pit.*

Managers regard the pit as the "back-bone" of the theatre. It is not consistent with public comfort that the pit seats should recede far under the first circle. Those occupying the back seats are subjected to inconveniences not experienced by the occupants of any other part of the theatre, not even excepting the gallery. That is the most satisfactory pit which does not extend beyond the enclosing lines of the circle front, although this arrangement seldom provides sufficient accommodation to please the management. The pit floor should have a sharp inclination as it recedes from

the partition dividing off the stalls. This should never be less than 1 in 24. The rake given to this floor is frequently excessive, with the result that the circle tiers have to be correspondingly raised, otherwise the occupants of the back part of the pit would have their view of the stage considerably curtailed by the soffit of the first circle. It should be possible for those standing at the extreme limit of the pit to see to a height of not less that 12 feet at the "curtain line." Private boxes should not be provided at this level, to the exclusion of either stalls or pit seats. Unnecessary inches given to private boxes may deprive the management of an appreciable income; *e.g.*, the removal of two private boxes at the pit level in a London theatre gave increased accommodation representing £6 nightly over and above the combined value of the two boxes. Stage-boxes are an abomination. A wood-block floor laid upon a concrete foundation is the best possible floor for the pit, being less noisy than a boarded floor, and more comfortable than cement.

The pit seats are generally continuous, and may be with or without back rails. The width of the seat need not exceed 9 in. or 10 in., but if fitted with back-rails the seat will have to be increased in width to 12 in. or 13 in. When the seats are "marked off" by painted lines or strips of webbing, 18 in. should be allowed to each person. If the inclination of the floor does not exceed a half-inch to the foot, the height of the seats may be varied with advantage; *e.g.*, the first rows 15 in., middle rows 17 in., and the back rows 19 in. high. The distance from back to back of the seats should be not less than 2 ft. 2 in., but when fitted with back-rails not less than 2 ft. 4 in. In the latter case a centre gangway will be desirable, otherwise gangways at each side of the pit, not less than 3 ft. 6 in. wide, will be sufficient, as the occupants generally walk over the seats.

### *Stalls.*

The dwarf partition usually separating the stalls from the pit should not be a fixture, but so arranged as to be easily removed for the curtailment of the pit or stalls, as occasion may require. This may be readily accomplished by having several light iron Standards, ⌶ section, fitting into sockets securely embedded in concrete. The partition may then be made in short lengths, and dropped into the grooves formed by the standards. In some theatres the stalls floor is level, but it is better "stepped" up,

rather than on the rake. These steppings should not be less than 2 in., nor exceed 4 in. high.

The width of the seats and area allowed to each person will depend upon the price and degree of luxurious comfort. The width may vary from 20 in. to 24 in. ; and the distance from back to back should never be less than 3 ft. It is not unusual to find the same description of seat fitted to the stalls and dress circle. This is not desirable, as the occupants of the stalls are generally looking up, and require to lounge in their seats, which should therefore be deeper, and the inclination of the back several degrees more than the dress-circle seats. In all cases the seat should, as far as possible, permit the occupant to comfortably accommodate himself to the angle of sight.

When space will permit, a centre gangway is desirable, in addition to those at the sides. A gangway also between the dwarf partition and the last row of stalls will be found of great service where the stalls are entered from one side only of the auditorium. This will avoid the necessity for passing "to and fro" in front of the orchestra—a proceeding that is particularly objectionable during the performance.

A separate entrance from the street to the stalls is very desirable. Subways should be avoided, as well as all unnecessary corridors and passages. These involve increased expenditure for upholstery, lighting, attendants, and cleaning.

### *Private Boxes.*

These in many cases recede from the proscenium at a considerable angle, which renders a sight of the stage only possible by leaning over the front—an operation uncomfortable in itself, and annoying to the occupants of the side seats in the circles, whose view of the stage is by this means interrupted. A judicious arrangement of the plan will obviate these inconveniences. Architects, too, frequently copy the "lines" of existing buildings without inquiring as to their adaptability, apparently believing that "whatever is, is right." The most comfortable boxes are those arranged at the back of the dress circle, yet custom permits the highest prices being demanded for the most distorted view of the stage. Movable chairs are generally provided for use in boxes, but where the space is limited hinged "flap" seats may be substituted with advantage. To be comfortable, a box should be

provided with a mirror, a small flap for use as a table, and an adequate supply of cloak-pegs.

Two or more boxes require at times to be thrown open, to accomplish which the partitions should be hung as folding doors or as shutters, or made to slide in grooves, and secured with bolts at the floor and ceiling.

*Royal Box.*

A separate entrance and approach are desirable, together with external verandah-cover and inner vestibule, private staircase, retiring-room, and lavatory accommodation. Electrical communication should be provided between the Royal retiring-room and the manager's room.

*Dress Circle.*

The form of the circle front demands careful consideration, as its shape may materially affect the spectator's view from the side seats. For large theatres—which are not advocated—the horse-shoe form, with the sides slightly converging towards the proscenium, is probably the best ; but for a small theatre the semi-ellipse, or modification of the three-centred curve, is the most desirable. The first row of the circle seats may continue round to the proscenium, in which case the floor of the proscenium boxes will have to be raised, and the box fronts should line with the second row of the circle seats. This arrangement is better adapted for provincial theatres than metropolitan. The height from the pit floor to the soffit of the first circle front should not be less than 9 ft., if an appearance of comfort is desired for the occupants of the pit.

The seats may be similar to the stalls, but should have a less depth of seat and inclination of back. It will further be an advantage to have the seats 1 in. or 2 in. higher than those in the stalls. The width of the steppings upon which the seats are fixed should not be less than 3 ft.

The height of the risers will vary according to the distance of the circle from the stage (see "Sighting and Acoustics," page 50), but it is desirable to increase the height of the back rows 2 in. or 3 in. more than the front rows demand. These extra inches in height will make all the difference between "seeing" and "not seeing" during a performance at *matinées* when ladies are permitted to wear their bonnets. To the architect and manager such apparently

insignificant details are worthy of consideration equally—if perfection is desired—with the external order of architecture or the style of the interior decorations. To further assist the view without increasing the height of the tiers, the back seats may be slightly raised upon wood fillets, 1 in. or 2 in. in thickness.

*Upper Circle.*

The front line of this circle should be set back from that of the tier below. This is desirable with the view to elegance, and in a small theatre is both an economical and structural necessity, in order to reduce the rake of the steppings.

Unless chairs are used, the seats may be continuous, with back rails, and divided by arm-rests or strips of white webbing. The seats should be 15 in. in width, and not less than 18 in. allowed to each person.

The steppings on this tier should be reduced to 2 ft. 6 in. in width. If this were exceeded, it would proportionately increase the height of the risers, and consequently the entire auditorium.

*Gallery.*

To avoid too sharp a rake to the seating, the front of this circle may have to be set back several feet beyond the circle front immediately below. In planning this part of the theatre care should be taken not to place seats from which a view of the stage cannot be obtained. Discomfort in the gallery will create disturbance, and consequent annoyance to the whole house.

The steppings forming the gallery will vary according to the height above and distance from the stage. The general width is about 2 ft., but 2 ft. 3 in. is more desirable, and the height of the riser 1 ft. 6 in. In no case should the height of the riser exceed the width of the stepping. This will represent a rake of 45 degrees, the utmost limit that either safety or convenience will admit. The seats should be continuous, and about 9 ins. wide, raised on blocks 2 ins. or 3 ins. deep, and slightly overhanging the nosing of the steppings. The seats may be marked off by an incision or painted line.

*Amphitheatre.*

When the front rows of the gallery circle are appropriated as an amphitheatre, a permanent division separates these seats from

the gallery. This part of the theatre is invariably approached from the gallery staircase, but a separate means of entrance is desirable.

### *Gangways.*

These should be carefully provided in the several parts of the theatre, and *never* occupied during a performance. This rule should be *rigorously* enforced by the authorities and management. Excessive width in the gangways entails loss of seating, whilst if too narrow it creates a feeling of insufficiency, and presumable insecurity.

The number of seats in a row should never exceed twelve without an intervening gangway. The *minimum* width of gangways should equal two seats in the respective section of the auditorium ; *e.g.*, stalls, 4 ft. ; pit, 3 ft. ; dress circle, 3 ft. 4 in. ; upper circle, 3 ft. ; gallery, 2 ft. 4 in. These latter should be double gangways, having dividing handrails firmly secured to the guard-rails fixed round the circle front.

A strip of white webbing should be fixed to the nosings of all steps in gangways.

## Managerial Offices.

The offices devoted to business and administrative work should be situated within easy access of the stage and auditorium. The managerial offices are in constant use from 10 a.m. to, in some cases, long past midnight ; it is, therefore, essential that the rooms should be spacious, cheerful, and well-ventilated. The varied nature of the business cannot be described in detail, but in a theatre the following accommodation is necessary, and cannot be dispensed with except at the cost of convenience :—

An outer office for clerks, *en suite* with the private rooms of the manager, treasurer, and secretary. The manager's room should communicate by speaking-tubes or non-electric telephones with the treasurer's room, box office, stage-door, prompt., and stage manager's room. In connection with the treasurer's room a public waiting-room is desirable, but so arranged that the business of "treasury days" may be conducted without inconvenience or blocking the approaches to the business manager's room. The treasurer's room should communicate by speaking-tubes with the manager's room, box office, and pay-boxes. Where possible, advice should

be obtained from the manager and treasurer as to the fitting up of their respective rooms. A matter frequently overlooked is the provision of lavatory accommodation for this department.

*Pass Staircase.*

A private staircase, giving access from the managerial offices to each section of the auditorium and the stage, is highly desirable. The acting manager has to visit, several times during the evening, the pay-places and check-takers, and these should be planned within easy communication from the "pass staircase." This "pass staircase" should be connected with a private entrance from the street. This will enable the officials to transact all business without coming in contact with the audience. The managers' offices, whilst commanding the theatre, should also admitof the utmost privacy. The management will condone many sins of omission and commission provided the working of this department is free from the friction arising from inconvenient planning.

*Transfer Staircase.*

This staircase should be placed in a well-defined and central position, communicating with each section of the auditorium. At each level a small "transfer pay-box" is required, and each door opening into this staircase should be in charge of an attendant, and only opened for the purpose of "transferring." The stairs may be not less than 3 ft. 6 in. wide, and it is imperative that it descends either into a main vestibule or direct into the street. In the latter case it would be available as an exit, should occasion require. This staircase may also be used as a "pass staircase" by the attendants and waiters—a very necessary arrangement where there is only one refreshment-saloon.

*Store-Room.*

This is highly necessary, and should be fitted with shelves and lock-up cupboards.

*Bill-Room.*

Usually this room is placed in any "out-of-the-way" corner, but it is desirable to have it in the managerial block. Here are kept the posters, play-bills, show-cards, &c., for which purpose several tiers of shelves are required, together with two or three lock-up

cupboards, and a strong table fixed permanently against the wall The room should be of ample size, and a portion screened off as the bill-man's office.

*Manager's Private Box.*

A box is usually set apart for the manager. This should preferably be one at the rear of the circle, from which a view of the entire stage may be obtained. Speaking-tubes are required from this box to clerks' office, prompt., and stage-manager's room.

*Attendants', or Ushers' Room.*

Proper provision is seldom made for the attendants, who, whether male or female, require a dressing-room within the auditorium section. This room should be fitted with lockers, a good supply of cloak-pegs, and lavatory accommodation. An indicator should be fitted, communicating with all the private boxes, manager's room, and the refreshment-bars.

*Housekeeper's Rooms.*

Sleeping-rooms should not be permitted within a theatre. Where dwelling-rooms are required for the caretaker, these may be provided in the administrative block, preferably on the ground floor, but in any case having direct access to the street. Communication should exist by speaking-tube or electric bell between the housekeeper's room and the manager's room.

ORCHESTRA.

For dramatic purposes the orchestra may be partially, if not entirely, under the stage. For opera, burlesque, and musical plays it is better within the auditorium ; the musicians are then able to watch the movements of the performers, in addition to which, the musical effect is enhanced. The floor of the orchestra should be constructed with wood, having a hollow space underneath. It is also desirable to line the sides and coved soffit of the stage with thin boards in long lengths. Entrance to the orchestra direct from the mezzanine of the stage cannot be approved. A passage of fire-resisting construction should connect the orchestra with the band-room or exit-passage from the stage. By securing the safety of the band, confidence and coolness on their part are created.

The conduct of the band during a panic is often of the utmost consequence.

*Band Room.*

This should be a room of ample size, fitted with lock-up cupboards for the storage of music and instruments, also with an electric trembling bell operated from the prompt. In the passage intervening between the band room and the orchestra a sound-proof, self-closing door should be placed, so that the discordant noises inseparable from tuning may not invade the auditorium.

*Musical Conductor.*

A small private room is required for the musical conductor contiguous to the bandroom, from which either bell or speaking-tube should communicate with the prompt. and stage-manager's room. A speaking-tube from the prompt. to the conductor's seat in the orchestra is also required. This seat should not be so raised as to obstruct the view from the stalls.

*Practising-Room.*

When the stage is occupied for dramatic rehearsals the orchestra cannot be used for musical practice ; a room, therefore, specially arranged for this purpose, should be provided when space will permit.

PROSCENIUM.

It is imperative that a solid and substantial brick wall should separate the auditorium from the stage. The dimensions of the proscenium opening demand most careful consideration, as upon these largely depend the arrangements both "before" and "behind" the curtain. (See Appendix.) Thirty feet is a good average width, and the height is regulated by the sighting ; any increase in the structural opening beyond this requirement will resolve itself into a question of architectural proportion or appearance. The occupants of the back seat in the gallery should be able to see any figures or action taking place "right up the stage." The structural opening is seldom the actual "working opening," the former being reduced by proscenium wings and borders. This fact should not be overlooked when setting out the lines of the auditorium. Grand proportions in the proscenium opening necessitate

equally grand proportions in the cost of scenery and other working expenses.

It is desirable that no openings should be permitted in the proscenium wall other than the proscenium opening itself. The Chief of the Metropolitan Fire Brigade advocates openings in the proscenium wall at each tier level, fitted with double iron doors. These the London authorities will not permit. In the event of a fire such doors might be useful to the firemen, but it is questionable whether their existence would not constitute a source of danger to the audience. The protective value of the proscenium wall is considerably reduced whilst the "great opening" is allowed to go unshuttered.

## Fire-Resisting Curtain.

The desirability of having a fire-resisting and smoke-proof curtain or shutter fitted to the proscenium opening has been recognised by the Continental authorities, who have made some such provision compulsory. Experience has not yet demonstrated the best form of fire curtain, but it is evident that any description of curtain which will retard the progress of the flames, and keep back the smoke from the auditorium, if even for a short period, is preferable to none.

Various forms of curtains have been suggested—from *water* to solid iron. The former idea is a practicable one, although some little difficulty might be experienced in maintaining an *unbroken sheet of water*. A water curtain would prevent the spread of fire for a certain time, but it would be useless as a shield to avert the falling of ignited timbers into the auditorium, although of value—for a limited period—in checking the spread of smoke. It, however, permits a fire on the stage to be seen by the audience—a decided defect. This objection may be overcome by using a double thickness of baize, the perforated pipe being fixed between the thicknesses at the top. The saturation of the baize would give weight and steadiness to the curtain to resist the gaseous pressures generated by a fire. In some Continental theatres a proscenium curtain of wire netting is compulsory. These curtains permit the fire to be seen, and therefore cannot be recommended. It is claimed for these curtains that they will prevent blazing woodwork or canvas falling among the spectators, and that for a time they

will turn back the current of air which is invariably drawn outwards from the stage towards the ceiling ventilator of the auditorium.

The asbestos metallic cloth drop curtain, fitted to theatres by the United Asbestos Company, 161, Queen Victoria Street, London, possesses many advantages to recommend it. The curtain is a description of woven asbestos metallic cloth, bolted or riveted to a light iron lattice frame, which latter works in vertical grooves, formed with channel iron on each side of the proscenium opening, and counterweighted somewhat on the principle of an ordinary window-sash. The curtain is light in construction, economical in cost, and easy of manipulation.

Of the several descriptions of fire-resisting curtains, probably none possesses so many desirable qualities as the iron curtains, but the asbestos curtains will, undoubtedly, find most favour with managers who are desirous of securing the public confidence, and a reasonable degree of safety, at a comparatively small outlay. These curtains have been fitted to several provincial theatres, and to Terry's Theatre, London.

The fire-resisting proscenium curtains fitted at the Lyceum Theatre, Edinburgh, and at the Prince of Wales's Theatre, London, are probably the nearest approach to perfection yet attained. They combine the three essential qualifications of a fire-curtain—1. For a certain definite period they are fire-resisting. 2. They are absolutely smoke-proof. 3. They do not permit the fire to be seen by the audience.

These curtains measure about 32 ft. 6 in. by 26 ft. 6 in., and are constructed of two screens of wrought-iron plates, $\frac{1}{8}$ in. thick, forming a double division, with an air-chamber between of 6 in. The top portions of the curtains are framed or riveted to double wrought-iron girders, secured to the head of hydraulic rams, which are fitted with their cylinders on each side of the proscenium openings. The curtains are worked by water obtained from tanks in the roof of main buildings, the waste water being discharged into a tank in the basement, and again pumped into the upper tank, the water being used over and over again. The curtains weigh from seven tons to eight tons each, and are raised or lowered in from thirty to fifty seconds, with an expenditure of only eighty-four gallons of water.

The working of the curtains is controlled by a lever in the prompter's box.

It is essential that the fire-resisting curtain should be controlled from the watch-room as well as from the prompt. It is also desirable that it should be lowered in conjunction with the act-drop. At one Continental theatre the iron curtain, which is decorated as a Persian carpet, may be lowered from three distinct parts of the theatre. The iron curtain cannot always be used in lieu of the "act-drop," its movement being too slow for what are termed "quick curtains" on certain striking dramatic situations.

## The Stage and its Appurtenances.

In the construction of the stage, with its arrangement of "cuts," "sliders," "bridges," and traps, and the necessary mechanical contrivances for working these, the services of a specialist or stage machinist are usually engaged. Architects seldom have the necessary technical knowledge to successfully design this section of the theatre unaided. There are, however, certain structural requirements which the architect will have to provide in his designs if the work of the stage machinist is to be ultimately satisfactory.

The size of the proscenium opening—more especially its width—in a measure dominates the entire structure: it is the key-note to the disposition of plan "before" and "behind" the curtain. A proscenium opening unnecessarily large materially increases the working expenses, as it necessitates increased proportions in the size of "flats," "wings," "back cloths," "borders," &c.

The stage floor is constructed with a number of "cuts," or narrow openings parallel with the curtain. These "cuts" are closed by strips of board, or shutters, termed "sliders," which are worked by a special mechanism under the stage floor, manipulated from the mezzanine. When the "cuts" are required to be open, the "sliders" are drawn away right and left from the centre of the stage, at which point the ends of the "sliders" butt. The "cuts" generally correspond in length to the width of the proscenium opening, and assuming the latter to be 30 feet wide, each "slider" would be 15 feet long. In order to draw off the "sliders," a space equal to 15 feet will be required on each side of the proscenium opening, and the *minimum* width of stage from wall to wall should therefore be 60 feet, or twice the width of the proscenium opening. Where the space is limited, "sliders" may be worked on the revolving-shutter principle, but this arrangement cannot be recommended.

A wide stage is to be desired; it facilitates the expeditious removal of scenery, avoids friction or confusion, saves time and possible expense, and is a *sine quâ non* where large "set pieces" are used. When designing the stage, the exigencies of the modern drama should be kept in view, in which "sets" and "properties" of immense size are much used. The limitations of site will govern the depth of the stage from the curtain line to the back wall. The depth of the stage, unlike the width, is not subservient to any arbitrary rules of working; and where actual depth is wanting, the scenic artist can do much towards concealing the deficiency by a careful adjustment of his perspectives. It is well to remember that a wide proscenium opening, together with considerable depth of stage, necessitate the employment of extra ballet and supers to fill it.

The stage floor should project some little distance into the auditorium, according to the general nature of the performances. For ordinary dramatic business this projection may be—as it frequently is—practically *nil*. For opera bouffe, burlesque, or spectacular shows, this projection may vary from 3 ft. to 9 ft. or 12 ft., as in the old Alhambra Theatre, London.

On the Continent and in some American theatres the floor of the stage is level, but the slight inclination given the stage floor in English theatres possesses many advantages to recommend it. The floor should rise from the footlights towards the back wall of the stage, the rake varying from 1 in 18 to 1 in 24. The latter is most usually adopted. Various arrangements of mechanical stages have been suggested and partially adopted in American and Continental theatres, but any contrivances that increase the number and complexity of the working parts of a stage cannot be recommended. An enormous revolving turn-table on the stage—a peculiar characteristic of Japanese theatres—enables one scene to be prepared in the rear whilst the performance is going on in front. This arrangement, although apparently simple, would, no doubt, lead to complication and trouble in working the "slider" and "bridges," &c., and for other reasons could seldom be used with effect. Mechanical changes of scene may be desirable in order to avoid "waits," but when carried out in view of the audience are generally clumsy, *always* inartistic. They tend to destroy the pleasing illusion of the play by the introduction of unnatural contrivances that are best hidden from the audience by "change curtains."

The height of the stage—*i.e.*, from the floor to the soffit of the "gridiron"—should be twice that of the proscenium opening. Assuming the proscenium to be 30 feet high, the height of the "gridiron" should be about 60 feet from the stage floor. In actual practice it will not be found necessary to adhere implicitly to this rule, for, as already pointed out, the use of proscenium "wings" and "borders" considerably reduce the structural opening in height, say 6 or 7 ft., which permits a corresponding reduction in the height of the "cloths." The height of the "cloths" in an ordinary theatre, having a proscenium 32 ft. high by 30 ft. wide, would be about 28 ft., whilst the width of the "cloths" would be governed absolutely by the distance between the "fly galleries." The "cloths" are invariably wider than the proscenium opening, and this varies from 5 ft. to 10 ft. in ordinary-sized theatres, and 20 ft. in large theatres, such as Covent Garden and Her Majesty's, London.

Large stages are not advocated, small stages being more desirable for comedies, farces, and comic opera, as the audience are better able to see the facial expressions and grasp the finer points in the acting. It should be possible in a well-constructed stage to draw up the "cloths" without rolling or folding. The use of "tumblers" when the "cloths" are folded—consequent on want of height in the stage—demands extra ropes and additional hands to manipulate them, whilst the cloths occupy three times more room than would be the case were they hanging down straight without folds. When the cloths are folded less scenery can be slung, hence crowding, confusion, and increased risk of fire. The importance of having the gridiron the requisite height may be estimated from the fact that at a representative London theatre an increased outlay of from £500 to £700 is required on each production, owing to the gridiron being a few feet too low, a fault in construction made by an architect hitherto credited with having a monopoly of knowledge as regards theatrical requirements.

### *Scene Docks.*

These should be level with the stage floor, and preferably at the sides rather than the back of the stage, as the scenes are then run into them direct. The dimensions of the "docks" in one direction should equal half the width of the proscenium opening. The "docks," when at the side of the stage, are occasionally divided

by brick walls, for the purpose of acquiring wall space and subdivision of scenery. This arrangement has its drawbacks—it interferes with the bodily removal of "sets" and large properties.

As it is not desirable to have more scenery on the stage than is requisite for immediate use, SCENE STORES should be arranged for the stowage of scenery not in use. In opera-houses these scene stores are absolutely necessary, and require to be on a more extensive scale than those in ordinary theatres. They should be situated near the carpenter's shop, and arranged for the easy removal of scenery to the painting-room.

### *Fly Galleries,*

usually denominated "the flies," are stagings or floors erected on each side of the stage, at right angles with the proscenium, and extending the entire depth of the stage. The width of the floor will vary according to circumstances, but on no account should it extend to within a less distance than 3 ft. of the proscenium opening, and where practicable, this distance should be increased from 5 ft. to 10 ft. As already mentioned, when the distance across the stage between the "fly-rails" is curtailed, the width of the hanging cloths is inconveniently reduced.

The joists forming the floor of the fly galleries are supported at one end on the side walls of the stage, and at the other on the bottom plate of a strongly framed "truss." The upper plate or head-piece of this truss is termed the "fly-rail," and should be of deep scantling, having bolted on to the gallery side a series of wrought-iron or hard-wood cleats. The ropes used for slinging the scenery are attached to these cleats, hence they are subject to considerable strain.

The height of the first tier of fly galleries above the stage should not be less than 20 ft.: it is desirable to make them higher, say 28 ft. or 30 ft., when they are less liable to be seen from the auditorium.

It is essential that staircases should be provided for access to the "flies" and "gridiron," which may be the same as those used for the dressing-rooms. The fly-ladders fixed on the stage, plumb against the wall, are not desirable. Having to be kept clear of approach, they curtail the available stage room, and managers will seldom venture on a tour of inspection when "Jacob's ladders"

constitute the only means of access to the upper regions of the stage.

The "grooves" fixed to the underside of the fly galleries in the older theatres, and used for steadying the "flats" and "wings," are now almost entirely dispensed with in modern theatres, as they necessitate all the scenes being set parallel with the proscenium. "Grooves" are still used in a modified form, but are attached to the lower rail of the "fly-truss," and turn upon a pivot, by which means wings, &c., may be set at any desired angle. Another arrangement is to fix iron sockets to the upper and lower plates of the "fly-truss," in which a long wood bar, about 3 in. square, works up and down, being fixed in any position by means of an iron pin fitting into a series of holes, specially drilled. At the lower end of this bar is attached a contrivance very similar to an enlarged garden rake. This works upon a pivot and between the teeth the upper edge of the "wing" or "flat" is secured.

These survivals of antiquated methods are entirely dispensed with in the more recent theatres, when the scenery is strapped together by cleats and cords, and secured to the floor of the stage by means of iron rods or braces, hooked to eyes attached to the framework of the scenery, whilst the other end is secured to the floor with "stage screws." The requirements for this arrangement have, of course, to be kept in view when preparing the framing for "flats," "wings," &c., which are usually about 18 ft. high. When the first tier of fly galleries are not sufficiently roomy, a second tier will be required, which should be from 7 ft. to 10 ft. above the first tier, or lower "flies." In very large theatres three tiers, and occasionally four tiers of "fly galleries" have been found requisite, particularly during pantomime seasons. The upper fly galleries should be connected by means of bridges, which may be suspended from the "gridiron" by iron rods, and it is desirable to have horizontal rods to act as hand-rails or guards. The best position for these bridges is parallel with and close to the proscenium wall.

### *The Gridiron,*

as its name suggests, is a species of naked flooring, and it forms an important and essential feature of the stage. The joists should be of more than average strength, and supported on the proscenium and back walls of the stage, and not on the tie-beams of the roof-trusses, unless these are of increased strength and

specially framed for the purpose, as the combined weights and strains upon the gridiron at times equal many tons.

In lieu of ordinary flooring, the joists of the gridiron are covered with battens 3 in. by $1\frac{1}{4}$ in., laid about three inches apart, or six inches from centre to centre. In the interspaces are fixed the blocks and wheels through which the ropes run that suspend the "cloths," the ends of the ropes being secured to the "cleats" attached to the fly-rails. The gridiron should be easy of access, and sufficient headway allowed between the floor and the roof to enable the fly-men to adjust the ropes and fulfil their duties with reasonable facility. A fly-man is neither a rat, to creep through a hole, nor a serpent, to work on his belly. The substitution of iron for wood in the construction of the gridiron, and, indeed, every part of the stage fittings, as far as practicable, would contribute to increased stability and safety. The gridiron is only constructed over that portion of the stage between the "fly galleries."

*The Mezzanine,*

or floor immediately below the stage, varies in height from 6 feet to 9 feet. The former height is preferable, as in the event of any "lever," "slider," or rope becoming fixed or detached, the defect may be remedied at once, without the use of steps or ladders. From this floor, which is frequently level—not raking with the stage floor—is manipulated the mechanism for lowering scenes, drawing off sliders, and working traps. Its position below the stage is somewhat analogous to that of the "fly galleries" above the stage.

The mezzanine practically constitutes a gallery round the "scene-well," which is an opening in the centre of the floor through which the scenes are lowered into the cellar below. The size of the scene-well equals the width of the proscenium opening and extends as far back as the cuts in the stage floor. The depth of the scene-well should be about 20 feet, measured from the stage floor. In very large theatres there is occasionally an upper and lower mezzanine.

*The Cellar*

is occasionally a floor immediately below the mezzanine, and about 7 feet high, in which case the scene-well is excavated to the required depth, forming a species of tank, some 3 feet or 4 feet

deep, in the cellar floor. This is not a desirable arrangement. It is preferable to have the cellar floor excavated to the level of the scene-well, as this, while slightly increasing the cost of the building, avoids complication in the stage mechanism. In the cellar are usually placed the larger windlasses and winches for raising the heavier scenery, bridges, &c.

Attention should be given to the drainage of the cellar, as the lack of this may become a fruitful source of trouble and damage to scenery and properties.

*Prompter's Box.*

In theatres of the future the prompter may have important functions to perform not at present associated with his calling. An escape-passage should lead from the prompter's box to an exit or point of safety. The "prompt" side of the stage varies according to circumstances, but it is generally on the right-hand side, looking from the auditorium, and the other side of the stage is the opposite prompt; hence the designation P. and O. P. sides At the prompt are fitted the index-plates, with valves for regulating the gas and electric lighting, likewise the lever for setting in motion the iron curtain, the signalling apparatus, the cords for releasing the trap-doors in the stage roof on the outbreak of fire, and the valves for regulating the shower-pipes. The prompt should be in communication, by single-stroke electric bells, with the P. and O. P. flies, mezzanine, cellar, and gridiron—by trembling bells, with band-room, stage-manager's room, watch-room, gas-man's room, manager's room, foyers, smoking-room and green-rooms—by speaking-tube or telephone, with manager's room and private box, musical conductor, and stage-manager's room, principals' green room, and WATCH ROOM.

*Stage-Manager's Room.*

Frequently one of the dressing-rooms is used for this purpose, but it is desirable that this room should be in the closest possible proximity to the stage. The stage manager should be in communication, by speaking-tubes or telephone, with the prompt, stage-door, and manager's room.

*Hand-Properties Room.*

Hand-properties are frequently placed in the charge of the "call-boy," and in some plays are very numerous. A small room

is required for their reception, in close proximity to the stage, and as near as possible to the entrance from the dressing-rooms. Apparent trifles will be accepted as a boon by the stage manager if they are conducive to order and the avoidance of confusion and waits.

*Scene-Door.*

An opening for the admission of scenery and properties is required in the outer wall of stage, not less than 4 ft. wide, and 18 ft. high. Where practicable it is desirable to provide large folding-doors, not less than 10 ft. wide, at the back of the stage, opening directly into the street or a cartway, but where the stage is considerably below the street-level there should be constructed a hoist for lowering animals, carriages, and large properties.

*Lamp-Room.*

Seeing that a large number of lamps are used for the supplementary system of lighting throughout the building, a room is required for cleaning, trimming, and storing during the day. One or more electric or safety lamps should be kept in the WATCH-ROOM for use in the event of gas escapes.

*Lime-Light Tanks.*

The tanks containing the gases for the oxy-hydrogen light should not be placed within the building, but fitted up in an open area or room specially constructed, and the gases forced by water pressure through metal pipes into the theatre. On no account should "lime-light bags" be manipulated on the stage or in the "fly galleries."

*Workshops.*

In a self-contained theatre provision must be made for the several trades connected with the business of a theatre; *e.g.*, carpenters, property-makers, modellers, smith, gas-fitters, wardrobe makers, and scene-painters. Under proper restrictions and the observance of reasonable care, there is comparatively little or no danger attending the operations of these trades. An immunity from risk can only be obtained by complete separation and structural subdivision of the several sections.

*Carpenters' Shop.*

When practicable, this shop should be at the stage-floor level; and as the "battens" used for mounting the "cloths" will be stored here, the length of the shop should exceed by a few feet the width of the proscenium opening, or, in other words, should exceed the width of the cloths.

*Property-Making Room.*

This room should be *en suite* with the carpenters' shop, having the means of communication fitted with self-closing iron doors, Both the carpenters and property-makers require specially constructed gas-stoves, for heating glue, size, &c. The stove for this purpose might with advantage be fitted in a small room, so arranged as to be used in common by carpenters and property-makers. Two private rooms are required in connection with the above trades, for the property-master and the chief carpenter, or stage machinist.

*Modelling-Room.*

This should be situated near the property-room, should be well lighted, and fitted with a special stove for drying purposes.

*Smiths' Shop.*

A room fitted with a gas-stove and small forge is required, available for smiths', gasfitters', and plumbers' work. In connection with this a small room should be provided for the chief gas-man, with electric bell and speaking-tube communication with the prompt and stage-manager's room.

*Wardrobe-Rooms.*

The number and size of these rooms must be regulated by the probable extent of the work to be done. Wardrobes are now largely made off the premises, whilst the wardrobe-mistress's duties are chiefly confined to the storing and repairing of the wardrobes in stock. In view of contingencies, it is desirable to provide a large work-room, fitted with tables and shelves; one or more store-rooms, fitted with wardrobe cupboards, drawers and clothes-racks; a small private room for the chief of this department, fitted with a cooking-stove and other conveniences and a fitting or trying-on room. This latter is absolutely necessary when ballet, chorus, and supers are largely employed

When practicable, these rooms should constitute a separate section of the building, and in any case all openings communicating with other departments should be fitted with self-closing iron doors.

Sanitary and lavatory accommodation should be provided for those employed in this department, and, indeed, in the planning of all conveniences it is desirable to remember that there is no department of a busy theatre that at times is not subject to overcrowding and extraordinary working pressure. The normal number of seamstresses employed may not exceed six, yet during busy seasons, and for some time before pantomimes, this number may be augmented to thirty or forty. Again, with regard to those employed on the-stage—actors, choruses, supers, stage-men, and others—these are subject at any time to an increase of from twenties to hundreds. Hence, in the arrangements of a theatre these possibilities should be born in mind by the architect.

### *Store-Rooms.*

A number of rooms of various sizes are required, in which to store properties, furniture, arms, armour, and materials.

A small vaulted chamber should be provided for red and blue fire compositions, which are liable to spontaneous ignition when not carefully manufactured. Several fires in theatres have been attributed to the use of these materials—notably at the Standard Theatre in 1866, and at Her Majesty's Opera-House in 1867.

### *Painting-Room.*

For some undefinable reason, the operations of scene-painting are a cause of prodigious terror to the authorities. Their fears are, however, without justification, as the melting of size on a gas-stove constitutes the only risk. The painting-room requires a good top-light, and the dimensions should in one direction exceed by two or three feet the length of the battens used for mounting the cloths. This room may with obvious advantage be placed over the carpenter's shop, or immediately above the stage scene-dock, in which case the "cuts" in the painting-room floor, through which the "paint-frame" works, should be fitted with iron flaps. The paint-frames are suspended against the walls by ropes with counterweights attached, and are raised or lowered by means of a winch or other contrivance, but

the best method of working is by hydraulic power. Frames may be suspended against the four walls—the longer sides for cloths, and the shorter sides for "flats," "wings," and other small pieces. In some cases the frames are stationary, the scenic artist working upon a bridge, which is raised or lowered as required. This arrangement is usually adopted where no painting-room is provided, and the "paint-frame" is fitted to the back wall of the stage.

Two small rooms are required for the scenic artist—one as a private room for designing, &c., and the other as a store for colours brushes, and other materials.

*Engine-Room.*

This will be an absolute necessity in future theatres. Gas-engines may be obtained, suitable and of sufficient power for all purposes required within a theatre, but when the engines are fed by fuel entire isolation of the engine-room is desirable. This room should communicate by electric bells and speaking-tubes or telephone with the "prompt" and "watch-room." An engine may be necessary for any one of the following purposes: pumping water from cellars; filling water-tanks over the theatre, for fire and hydraulic-power purposes; raising and lowering the metal curtain; working the hoist in connection with the stage; driving exhaust and delivery fans for ventilation, and dynamos for the electric light; or pumping sewage to a higher level, &c. A small room, too, should be provided for the engineer.

*Furnace.*

The refuse and sweepings from the stage and auditorium, waste and shavings from the workshops, chips, wardrobe-cuttings, or rubbish of any description should never be allowed to accumulate, but should be destroyed daily, in an iron or brick furnace, constructed outside the building. A small receptacle will be required for the ashes, and these should be removed every week.

*Stage Entrance.*

Some little pretension should be given to this entrance, and, in any case, the squalid, dirty, insignificant portal usually designated the "stage-door" should not be perpetuated. This entrance should be in close proximity to the staircases leading to the ladies' and gentlemen's dressing-rooms.

*Hall-Porter's Room.*

The hall-porter is on constant duty at the stage entrance, from 10 a.m. until the last performer has left the theatre at night, therefore his room should be fitted with reasonable conveniences, including a stove suitable for cooking, a lock-up cupboard, and, if practicable, lavatory accommodation. The other requirements of this room are, briefly, a small sliding window, opening into the passage, a rack for the dressing-room keys, an alphabetically arranged receptacle for letters, one or more framed boards for "notices" and "calls," and a few cloak-pegs. Speaking-tubes should communicate from this room to the prompt, manager's room, and stage-manager's room.

*Dressing-Rooms.*

Theatre architects have been accused, not without some show of reason, of neglecting to provide necessary accommodation for the performers. This neglect may arise from carelessness or indifference, but it is more frequently the outcome of restriction as to cost. It is not to the architect's monetary or professional interest to design buildings devoid of the requisite accommodation. Too frequently, however, proprietors ignore professional advice, and insist upon the sacrifice of essential requirements, to secure a gaudy display of decorations and an excessive number of seats. The dressing-room accommodation in many theatres is of such a character that had the problem been to combine all those conditions most inimical to health and comfort, it could not have been more satisfactorily solved. Indeed, sanitation, both before and behind the curtain, is in some theatres a matter so utterly ignored that the buildings are quite unfit for the reception of either the public or the actors. Such a state of things indeed would be impossible did the sanitary and other authorities responsible for public health and decency faithfully fulfil their responsibilities.

Unless the area of the site is small, it is not desirable to restrict the number of dressing-rooms, and in any case a number of small *single* dressing-rooms are better than a limited number of larger rooms, in which actors are thrown indiscriminately together, without any regard to comfort or privacy. The dressing-rooms should constitute a distinct block, and be separated by a fire-resisting lobby or corridor from the stage. This block should be divided

into two sections, having separate staircases and approaches for the men and women, with distinct sanitary conveniences provided on each floor.

The dressing-room staircases, whilst being fire-resisting, should be arranged for *quick* and easy access to the stage, and at the same time be so cut off from the stage and auditorium that the noises created by persons running up and down may not annoy the performers nor disturb the auditorium.

Arrangements should be made for signalling from the prompt to the dressing-rooms in the event of fire on the stage.

The essentials to a good and comfortable dressing-room are—1. Daylight. 2. Fresh air. 3. Warmth. 4. Adequate table space and drawers. 5. Clothes-racks, or, in lieu, a good supply of cloak-pegs. 6. An abundant supply of hot and cold water, laid on to the wash-basins. The dressing-rooms should be well ventilated, and kept at a temperature ranging from 60 deg. to 65 deg. Fahr., by means of hot water or warmed air. The ordinary open fire-place and coal fires cannot be recommended. They are neither safe, economical, nor cleanly. It is well to remember that the temperature of the dressing-rooms materially affects the occupants, and exerts a not unimportant influence on their performance. On this subject a leading professional lady, recently deceased, remarked to the author that "to dress in a cold room chills every feeling, and renders you physically unfit to perform your part satisfactorily." Hence the necessity for warmth and ventilation without draughts.

To one or more sides of each ordinary dressing-room, tables should be fixed, 1 ft. 6 in. wide, and 2 ft. 6 in. high. In connection with these tables, lock-up drawers, 10 in. or 12 in. deep, should be constructed, having drop-handles in preference to knobs, and to each table should be fixed a large wash-basin, with hot and cold water laid on, and the necessary waste-pipe. In preference to fixing hooks to the walls, there should be a clothes-rack in the centre of each room, having shelves and hooks, and iron rods to attach dust-cloths, so that these latter may be drawn entirely round the rack.

### *Star Dressing-Rooms.*

Two or more star-rooms should be arranged, as near the stage as practicable, in each section of the dressing-room block. These

rooms should have connected therewith separate lavatory and dressing accommodation and sanitary conveniences.

*Supers' and Ballet Dressing-Rooms.*

In addition to the ordinary dressing-rooms, large rooms are necessary for the supernumeraries and the *corps de ballet*. In these rooms the dressing-tables may be continued round the four sides, with an additional centre table of double width, if the size of the room will permit.

For each person a gas bracket and looking-glass should be provided, and where the space will not permit of clothes-racks there should be a plentiful supply of hooks on the walls as well as of drawers under the tables.

*Ballet-Mistress's Room.*

Where the ballet is frequently engaged, private rooms are desirable for the ballet-mistress and the ballet-master.

*Children's Room.*

At certain periods children are largely employed. It is therefore desirable to provide rooms for boys and girls, with lavatory and other conveniences. The children are generally in charge of dressers, and platforms or stout benches placed alongside ordinary dressing-tables will be found to meet all requirements.

*Green-Room.*

The green-room is a characteristic feature of the older theatres, and it is intimately associated with all the more pleasing reminiscences of the past history of the stage. Now, however, in all properly regulated theatres outsiders are not permitted within the precincts of the stage, and the green-room is devoted to its legitimate purpose as an *ante-room* to the stage, its use being confined strictly to the performers. A green-room is not so much a real necessity of the modern theatre as in the past. Greater attention has within recent years been devoted to the actors' dressing-rooms. These in new theatres are comfortable and well-appointed, with the result that the principals prefer the privacy of their own rooms during the intervals. When a green-room is considered necessary it should be of ample size, warmed, venti

lated, and appropriately furnished as a drawing-room or lounge. Its position should be close to the stage, but cut off from direct communication by means of sound-proof doors. Perfect silence is difficult of attainment when large numbers are employed on the stage, and in the green-room incessant talking is the rule, and proves a source of annoyance to the performers. In addition to its special use, the green-room is available for the reading of new plays, consultations, &c., &c. Communication with the prompter and stage-manager's room by means of an electric-bell and speaking-tube should be provided, and every reasonable effort should be made to render this room light, commodious, and comfortable. An attempt at adornment is both permissible and desirable. Portraits or busts of stage celebrities, and scenes from plays associated with the theatre, in conjunction with other works of art, greatly enhance the interest and keep alive the local reminiscences of the drama.

*Supers' and Ballet Room.*

In a large theatre it is desirable to provide a waiting-room for the supers and ballet. This should be a room of ample size, so that it may be available for ballet practice or dramatic rehearsals at such times when the stage is otherwise occupied.

*Music-Room.*

It is most necessary that a large theatre should contain a music-room wherein a pianoforte may be placed, in which principals or chorus may at any time rehearse. This room should be as far as possible from the stage.

*Bath-Rooms.*

One or more bath-rooms, fitted complete in every respect, will be found a desirable adjunct to large theatres, and will be well appreciated. A shower bath might with advantage be fitted in each section of the dressing-room block.

*Library.*

Contiguous to the principal green-room, or in the administrative block, there should be a fire-resisting room with an iron or thick oaken door, available as a reading-room or library, and for the storing of dramatic and musical literature, scores, manuscripts, &c.

Such a room would be largely patronised during the interval between morning and evening performances.

*Meter House.*

A room is required, especially constructed, well ventilated and lighted, in which to place the several gas meters.

*Exits.*

In the event of fire on the stage the actors, scene-shifters, and other stage workmen are the first exposed to danger. They are also the first called upon to make desperate efforts in the way of saving life and securing property. Their sense of personal safety should be assured by the provision of ready means of escape when driven from their posts by a fierce fire.

*Counterweights.*

Care should be taken to encase all counterweights, and such provision should be made that in the event of ropes breaking or weights becoming detached, no injury to individuals would arise.

DRAINAGE.

To those conversant with the vicissitudes of a theatre, the frequency with which the drains "go wrong" will be a matter for little surprise. This arises from several causes—defective construction, absence of supervision, carelessness on the part of cleaners, and neglect to periodically flush the drains. The drainage of a theatre is seldom designed upon a scientific plan. Arrangements should be made for the thorough ventilation of each section, and the several parts should be so disposed as to admit of ready inspection. Flushing and inspection chambers should be provided in convenient positions, and where these are not practicable it should be possible from some single point for the fireman to turn his hose into the drain and scour out the entire system. The rain-water from the roofs should enter the drains at points most likely to be effectual in flushing the pipes. In connection with the drainage it frequently occurs, when stoppages arise, that the direction of the pipes has to be *discovered.*

Owing to frequent changes of tenancy, no one in the building knows the direction, fall, or point of junction with the main sewer,

a lamentable ignorance prevails also of many other details in construction.

To avoid these difficulties, managers should have ready for immediate reference, plans as follow :—

1. Showing the system of drainage, direction of soil, water, and waste pipes ; position of inspection and flushing chambers, and the point of connection with sewer.
2. Gas-pipes, position of meters, and switch from main ; stop-cock, and condensation tap. The separate sections of lighting to be indicated by different-coloured lines.
3. Water-pipes with position of hydrants, water-pressure gauge, tanks, and sluice-valve. The hydrants supplied from the main and tanks distinguished by different-coloured lines.
4. Electric-light cables, position of dynamos, accumulators, convertor, and "switch" or cut off.
5. Direction of telephone wires.
6. Direction of speaking-tubes and electric-bell wires.

### Cleaners' Room.

A theatre requires cleaning thoroughly each day. One or more cleaners' rooms are necessary for the storage of brooms, pails, watering-cans, &c. These rooms should be fitted up with a slop-sink, one or two cupboards, and the water laid on. When slop-sinks are provided, cleaners should never be allowed to empty their pails down the water-closets. Such a proceeding may cost the management many pounds during the year.

### Firemen's or Watch Room.

A good position for this room is near the main vestibule, but with direct access to the managerial "pass staircase." A fireman may be required at a moment's notice, yet he is frequently the only employé in a theatre having no fixed quarters. From the watch-room the fireman should be able to get to any part of the theatre in the least possible time. The room must be fireproof, and exit therefrom ensured, thus giving the occupant increased confidence. One fireman should always be on duty in the watch-room, and electrical or telephonic communication should be pro-

vided to the manager's room, stage-door, prompt, the several entrances, engine-room, nearest fire-brigade station, and police station. It should further be possible for the firemen patrolling the theatre to send messages from several parts of the building to the fireman on duty in the watch-room—*e.g.*, from each tier-level, the flies, workshops, and dressing-rooms. An indicator should be fitted showing the pressure of water in the hydrants, and a "lever" to lower the fireproof proscenium curtain in the event of an alarm being received from any part of the building. In this room should also be fitted the "switches" for cutting off the gas, electric light, and water, also the valves for regulating the whole of the auditorium gas-lights, with the exception of the sun-burner. There should also be fitted an indicator, registering the quantity of water in the tanks.

## Fireproof Doors.

The necessity for fitting fireproof doors to all openings communicating with separate sections of the theatre building is readily admitted by the authorities, yet the real efficiency of these doors is apparently little considered, judging from the attenuated specimens, fireproof only in name, which are usually found in theatres.

The Metropolitan Board of Works, in their requisitions to owners of theatres, lay particular stress upon the necessity for all iron doors being self-closing. This is very essential, and to meet the special requirements of theatres, Messrs. Hobbs, Hart, and Co., 76, Cheapside, London, E.C., have designed a fireproof door, fitted with a "self-closing attachment." These doors have been approved by the authorities, and their use sanctioned in several places of public entertainment—notably at Covent Garden Theatre, London.

The principal American Insurance Offices recommend a form of fire-resisting door "put together in two thicknesses of tongued and grooved boards, crossing each other diagonally and nailed together; over this are laid, on both sides, sheets of tin bent over at the edges, forming locked joints." This form of door has withstood intense heat, and retained its shape unaltered.

A solid wood door, formed with planks two inches or three inches thick, having a sheet of metal or asbestos between the two thicknesses and covered with a coat of plaster, and the edges thoroughly protected, would resist a fire that would contort nine-

tenths of the so-called fireproof iron doors into a shapeless mass. Fireproof doors are also made with concrete in iron frames.

### Internal Doors.

These, when in the line of exit, should be equal in width to the external doors, and open in the direction of *exit only*. Swing doors occasion unpleasant collisions. To prevent slamming, internal doors should be fitted with india-rubber stops or the Norton door-check and spring, which is an admirable contrivance for this purpose. Spring stops should also be fitted in the floor to hold open internal doors during the exit of the audience. When a door is required merely to exclude the draught, curtains may be substituted, but these should be hung on hinged rods to open as a door in the event of panic. The upper panels of internal doors may be glazed and protected with metal guards, but on no account should bolts or fastenings be attached to doors other than those opening into private rooms, pass staircases, or doors of communication. All locks should be fitted *en suite*, and "pass" keys provided for the managers and firemen. Passages and corridors leading to external doors are safest in proportion to their width, and when more than 6 ft. wide may with advantage be divided longitudinally by a stout barrier: this will reduce the pressure from crushing. All corners and projections should be rounded off, and, if practicable, slopes substituted in lieu of steps, and never, under any circumstances, should there be a single step in a corridor. As the avoidance of noise is essential, the dressing-rooms and other departments should be shut off by soundproof doors from the stage, so that disturbing noises may not annoy the performers, nor penetrate into the auditorium.

# SIGHTING AND ACOUSTICS.

To the professional reader it will appear a reflection on his intelligence to suggest that in buildings intended for the reception of the public the lines of the interior should be so designed that each person may receive a direct and uninterrupted *ray of sound*, and an uninterrupted *sight* of the speakers. For the lay reader who visits a theatre—designed on the most approved principles—to find that there are seats from which only two-thirds of the stage can be seen, the other third being cut off by a vertical line formed by the private boxes, the *possible* perfection of the sighting will awaken a sense of prospective pleasure. This is both possible and practicable, and its acquisition merely demands a careful adjustment of the "lines" of the interior, and the solution of minor constructive problems.

Past failures in respect to sighting are largely attributable to the designers having failed to realise that the conditions contributing to perfection of sighting in a church or lecture-hall, where the speakers are stationary, are not compatible with the exigences in a theatre, where the speakers are continually changing their positions. In the former case the "sighting" is to one single point, whilst in the latter it must be equally good to a series of points extending along a line parallel with the spectator, and some 20 feet or 30 feet long, according to the width of the proscenium opening.

The most usual method adopted to find the rake of the seating is as follows: Having settled on the "sectional drawing" [the position of the floor of the first row in the dress circle], a point should be fixed 3 ft. 6 in. to 4 ft. below the stage floor at the front, or point nearest the spectators, and from this point an extended line touching the nosing of the first stepping. To this line the nosings of the other steppings should be tangent. Having fixed the position of the first row in the second circle, a line should be drawn from the point below the stage floor as above described. To this line the nosings of the steppings should be tangent. This method is also applicable to the gallery. The soffit of the front row of the second circle should not be less than 8 ft. from the stepping which it immediately overhangs in the circle below. This distance is

frequently less, resulting in discomfort, semi-suffocation, and depression arising from the audience having a ceiling within a few inches of their heads. Further, persons placed under a gallery can seldom hear satisfactorily. This defect arises from the comparative smallness of the space in front of the circles through which the sound enters.

The actual structural opening is further restricted by the audience, whose clothing also *absorbs* a large proportion of the sound rays.

By arranging the height of the steppings on the foregoing plan with the nosings tangent to a radial line drawn from the point 4 ft. below the stage floor, it is evident that the occupants of the centre part of the circle will have a good view of the stage, whilst those at the extreme sides will have a portion of the stage cut off from their view by the circle fronts. Various expedients have been adopted to overcome this defect. In some cases the seats at the sides are raised, or dropped two or three feet bodily, together with the box fronts, thus breaking the continuity of the arm rest, which detracts considerably from the appearance of the interior.

Before the circle fronts are fixed, a good view of the stage is generally obtainable from every point. The method usually adopted to overcome the defect in sighting is to lower the floor of the first row in each tier, the rake being from the centre of the circle towards the proscenium. This fall of the floor gives a corresponding rake to the top of the circle front, which latter is the real obstacle to an uninterrupted sight of the stage.

The steepness of this rake will be increased in proportion to the nearness of the circle fronts to the curtain line, and it is seldom that a uniformly good result is obtained when the circle fronts are *level* with the steppings.

The requisite rake to the circle fronts can only be found by a test section set up on a line parallel with the longitudinal axis of the auditorium, and say about 2 ft. from the extreme sides of the proscenium opening. The raking fronts to the circles cannot be recommended on artistic grounds, however necessary for practical "sighting." The appearance of the interior suggests a tendency of the entire auditorium to fall towards the stage. There is no repose in the structural lines, whilst the impression conveyed to the performers is unpleasant to a degree, and this particularly

applies where there is little depth in the auditorium but excessive height, when the interior becomes in ordinary parlance "a well." Having regard to architectural and decorative consistency, no interior can be deemed satisfactory in which the circle fronts are on the rake. The horizontal lines are out of level, and to the eye the stability of the interior is destroyed. To overcome this objection there is no practical reason to prevent the first, and in some cases the second row, together with the circle fronts, being level, and the back rows constructed with an inclination from the centre towards the sides sufficient to obtain the requisite line of sight. This reverses the ordinary practice, but would undoubtedly give satisfactory results as regards the sighting, whilst at the same time retaining a consistent treatment of the architectural and decorative features of the interior.

When "setting up" the sections of the theatre it is desirable to sight from the eye level of the spectator, which for practical purposes is 4 ft. 2 in. from the floor when the spectator is seated, and 4 ft. 10 in. to 5 ft. when standing.

The theoretical principle to adopt when fixing the height of the steppings upon which the seats are placed is as follows: Having decided upon the floor level of the first row, set up the position of the spectator's eye 4 ft. 2 in. above the floor vertical with the back rail of the seat. Now from the point—4 ft. below the stage floor, previously alluded to—a line should be drawn cutting through the eye point of the spectator in the first row, and produced until it cuts a vertical line set up at the back of the second row. Then from the point where the vertical and radial lines intersect at the second row, if 6 in. is measured up, that point will give the eye level of the second row. From the point below the stage floor a line drawn through the eye level of the second row, and produced until it intersects the vertical line set up at the back of the third row, and from that point again measured up 6 in., that will give the principle upon which the eye level may be found for each row, and from each eye level 4 ft. 2 in., measured down, will give the floor level for each stepping.

When the heights of the steppings are obtained in the foregoing manner the nosings are not tangent to a straight line, but to a concave curve, and the steppings are not equal in height, but become steeper as they recede from the stage. This curve has been named "the isacoustic," or equally hearing curve, and is a refinement

seldom practised when setting out the seating for a theatre, the simpler plan of making the steppings tangent to a radial line having been found to meet practical requirements. When this method is applied to the pit floor, the point from which the radial lines are drawn may be fixed at the stage level, the result being that the floor will be "dished." The foregoing arrangement possesses undoubted acoustic advantages, but in so far that it necessitates an excessive rake in the floor, it has not been universally adopted. To apply it without modification to a galleried building like a theatre is impracticable.

The rake given to the pit floor is frequently more than the exigencies of a reasonably good view of the stage demand. The several tiers are consequently elevated, and the gallery raised a considerable distance above the auditorium ceiling. This elevation of the gallery ceiling is objectionable for several reasons, and it is evident that the most desirable form of ceiling is that which continues on the rake from the proscenium wall in one unbroken continuity of surface until it touches the back wall of the auditorium, and this inclination of the ceiling may with advantage correspond with that of the pit floor.

The theatre architect will have some little difficulty in producing a building that, whilst combining all the qualities of acoustic excellence, shall at the same time meet the requirements of fire-resisting construction. To harmonise scientific construction with the successful propagation of sound will entail upon the designer more than usual deliberation. The requirements pertaining to improved theatre construction as demanded by the authorities are in no way compatible with those satisfactory conditions looked for by the spectator. Large crush-rooms, spacious corridors, and numerous exits, with their corresponding openings into the auditorium, combined with the hard, compact materials used in fire-resisting construction, all tend to increase the difficulties of attaining acoustic excellence.

The theory of acoustics treats of subtle and abstruse phenomena, difficult of practical application even in buildings where no restrictions are imposed inimical to success. Where absolute freedom in the choice of materials is admissible, the difficulties are reduced, but even then it is questionable whether success can be guaranteed. Buildings have been constructed on professed theoretical principles, yet the result has been dire failure, whilst other

buildings erected with but little regard to theoretical requirements have, by a mere fortuitous combination of form and materials, proved perfect models for the propagation of sound.

Much stress has been laid by some writers upon the harmonic proportions of rooms used for musical and dramatic purposes. This subject is involved in abstruse theories which hitherto have failed in their application to produce an interior the excellence of which could be reasonably attributed to strict adherence to harmonic proportions irrespective of constructive materials and other favourable conditions. It is a primary necessity of acoustic perfection in a theatre that the auditorium should not exceed in size the limits of the human voice when reasonably exerted. With this view an opera house may consistently be larger than a theatre for dramatic representation.

Saunders, in his treatise on theatres, published in 1790, observes that when a person is made to read from a book on a still day in an open plain he could be heard 92 ft. in front, 75 ft. on each side, and 31 ft. behind. In an ordinary building many conditions are present which combine to prevent the uninterrupted transmission of sound. No building can equal the open air, hence the acoustic excellence of the Greek and Roman theatres.

Sir Christopher Wren was of opinion that, given good articulation, the voice may be heard in churches 50 ft. in front, 30 ft. on each side, and 20 ft. behind the preacher. This latter calculation comes nearer the normal powers of the human voice, and it has been authoritatively stated that "a theatre will be within the range of the natural direct radiation of sound where no person is farther than 70 ft. from the speaker," and that such a theatre would seat 2000 persons.

Another writer on the subject observes that "a speaker can be heard at a greater distance in front of him than on either side, behind him, or vertically—thus 90 ft. is the distance in front, 75 ft. that on either side, 30 ft. behind, and 45 ft. vertically."

These distances, presumably, apply to conditions existing in an equable temperature. In actual practice it is frequently possible to hear the performers' voices in the gallery of a theatre with greater distinctness than in the lower parts of the house: this may arise from the ascensional power of the atmosphere, produced by increased temperature, and partly from the sound-waves failing to penetrate under the overhanging tiers.

Sound radiates in all directions, travelling at a uniform rate of speed, but with constantly diminishing strength as it recedes from its source, for which reason a practical limit is imposed on the size of the auditorium. No person should be removed farther from the stage in a dramatic theatre than 75 ft., nor the angle of vision exceed 45 deg. The former may be exceeded in opera houses, where the voice in singing travels farther, and the number of tiers may be increased, for it is more natural to sing upwards than downwards. The natural action of throwing back the head and chest, to give the lungs free play, has the tendency to direct and send the voice *upwards*. Sound naturally follows a straight course, which may be modified by intervening objects. The substances used for constructive and decorative purposes may either reflect, conduct, or absorb the sound, according to their composition.

Wood has hitherto proved to be the best material for the interior lining of theatres. Upon this subject Saunders observes: "Wood, being of all materials the most favourable to sound, should be adopted in a theatre in preference to every other, not only in the divisions, but the walls and even the ceiling should be lined with it, for which purpose recourse must be had to an ingenious joiner, as by his assistance great effects may be produced in an immense theatre. In lining the ceilings and walls, care should be taken to leave sufficient room behind not to hurt the elastic property of the boards; they should be united in a most artful manner, and the bearers to which they are fastened placed at the greatest possible distance."

This corresponds with the recommendations of the Congress of Architects and Engineers held in Italy in 1880, who discussed the question as to the form, materials, and decorations proper for a hall of music, and for a modern theatre in particular, and agreed that—

"1. Wood is the proper material to choose in order to augment the energy of sound in a room adapted for music, that it is the best when of uniform fibre, and especially fir.

"2. That only one kind of wood should be used in the construction of any single room in which the distinct and uniform distribution of sound is desired.

"3. That the floor under any sonorous body should be hollow,

placed over a compartment also made of fir, and isolated.

"4. That it is most desirable that such a hall should be lined with wood, isolated as much as possible from the general fabric of the building.

"5. That the soffit of a theatre, the archivalt of the stage, and the fronts of the boxes should have their superficies composed of thin planks fitted together like boxes, and that if it is necessary to employ columns, they should be of wood, and hollow within.

"6. The form of music-hall should be curvilinear. The elliptic curve is best. For a theatre the horseshoe form should be maintained. It is best when the extremes of the semicircle are prolonged in parabolic lines, so as to present the form of a racket.

"7. The stage should be constructed as a separate compartment (the term used is *cassa armonica*—musical box), that it should be regarded in great theatres as the most important part of the building.

"8. The back of the stage-boxes should be curved and covered with low roofs. It would be better to eliminate these boxes altogether.

"9. The soffit of the building should be concave, brought low at the sides, with an ample width round it.

"10. The front of the boxes should be continuous and low.

"11. In order to increase the musical effect of a theatre, the stage should be as large as possible."

Professor Roger Smith, writing after the fire which destroyed Her Majesty's Opera House on December 6th, 1867, says: "That all the interior faces of the building, those against which the vibrating mass of air impinged, were of resonant material, *i.e.*, of dry wood, in as long lengths as possible, and fixed at as few points as possible, and to this construction were mainly due the very remarkable acoustic qualities. Nor is there, so far as I am aware, any possibility of securing this advantage with incombustible materials."

And again, in his work on "Acoustics of Public Buildings," the above authority observes: "The plan of this building presents an end a little more than a semicircle, prolonged by two almost straight sides, which gradually approach each other as they reach

the proscenium. The stage is remarkably shallow behind the curtain, but is advanced far into the house, so that any singer who is at its front has the audience all round and even partly behind him, and the orchestra, being in front of the stage, is even more among the auditors. There are no columns or other ornaments about the proscenium, and the ceiling, which is a flat segmental curve in part, is brought down towards the opening of the stage so as to throw the sound forward ; and there is no roughness on the faces of the boxes, which are perfectly plain, flat faces, devoid of all moulding or projection. The form is favourable for sound ; the space above, behind, and at the sides of the stage is restricted as much as possible, and gradually swells out into the body of the house ; while the divisions of the boxes, which do not radiate from the stage, would prevent any echo from the back wall, and break up any wave of conducted sound. More important, however, than all the favourable combination of form presented is the circumstance that again the whole interior, including fronts of boxes, divisions between them, the gallery, and even the ceiling, is formed in wood ; the audience are almost as though they were within some gigantic violin, and the whole included atmosphere were alive with the musical vibrations of its walls."

A writer referring to Her Majesty's Opera House in 1864, observed : "That it was the very best theatre in the world for sound, and was certainly built without any scientific principles of acoustics. In shape it was like a drum, and the wall of the auditorium was flat. There were no projecting ornaments of any kind. The outside of the boxes were flat and even, and the ceiling was perfectly smooth, without any ornamentation in relief, and the form that of a slight dome. The pit tier fitted tight on to the floor. In this short description we have the whole secret of good sound." When resonant materials are referred to, wood is usually considered as the only building material available for the purpose. This may not be strictly the case, but an authority upon acoustics observes : "The resonance of wood is so far more pliable, that is to say, ready to lend itself to *all* sounds, than that of other substances, and has so little 'ring,' or disposition to continue sounding after the original sound has ceased, that no material is comparable to it, or could replace it, even were it less available than it is for the purposes of the builder ;" and again, "Where fireproof construction is deemed essential, it may be desirable to

introduce a resonant material, and yet inexpedient to make use of wood. Membranes stretched tight seem to offer an expedient worth considering, though the practical difficulty of keeping them always in uniform tension would perhaps prevent their applicability. The employment of thin plates of some hard metal, such as bell-metal, in such situations as have at other times been filled in with panels of wood, suggests itself as an expedient worth trying, where an incombustible resonant material is required."

The unanimous opinion expressed with regard to the use of wood where good acoustic results are desired, almost debars the possibility of its not being used in the manner advocated.

The dangers attending its introduction into theatres with the existing methods of illumination are self-evident, and do not call for special proof. And again, however essential the use of wood lining may be in buildings of *large size*, its introduction into theatres that are reasonably within the compass of the human voice is not an absolute condition of acoustic success. Now that science has provided the means to render wood uninflammable, coupled with the use of the electric light and the adoption of reasonable precautions, the application of wood to the construction of theatres and concert halls is deprived of the one serious objection to its adoption, whilst its use adds incalculably to the acoustic properties of the building.

There are few, if any, materials used in the ordinary methods of fire-resisting construction that will aid the *reinforcement* of sound. In this respect wood is without rival. It alone is a suitable material for the construction of sound-boards, the bodies of guitars and violins. The vibrations of the strings throw the wood or reinforcing body into *sympathetic* vibration, and this is not compatible with the smooth, hard, inelastic surfaces associated with fire-resisting construction. These may, however, aid the conduction, reflection, or absorption of the sound.

To avoid the reflection of the sound-waves, the hard-smooth surfaces should be covered with a material of slightly rough, uneven texture. Sound-waves impinging upon surfaces smooth and non-sonorous, recoil, and occasion confusion of sound by their intermingling.

In the construction of theatres it may be accepted as an axiom that wood is only essential for accentuating the sound when the auditorium is of such a size as to be beyond the capacity of an

ordinary human voice. Further, there appear no insuperable scientific difficulties, preventing the construction of a fire-resisting theatre that shall combine all reasonable requirements for the propagation of sound and the economy of speech.

With the view to obtain the best result, the orchestra should be within the auditorium, and not partially hid under the stage floor. This latter expedient is adopted in order to acquire increased accommodation in the stalls. If wood is permissible at all, it should certainly be used to line the floor and sides of the orchestra. The battens should be placed a few inches from the walls, and fixed at the fewest possible points.

Under the floor of the orchestra should be a hollow space or trench to assist the reinforcing and vibrating qualities of the wood. A space under the pit floor has been advocated, but this is unnecessary, as nearly all the sound-waves are absorbed by the clothing of the audience, and do not, therefore, act upon the resonant material forming the floor.

In some buildings giving the best acoustic results the floors have been of *earth*. The ground is seldom productive of confusion either in speech or music, and being comparatively soft and externally rough, it causes no reaction from the roof. Nature cannot be strictly followed in a theatre, for self-evident reasons. The best substitute is undoubtedly a wood-block floor laid on concrete, with an intervening layer of some elastic composition or felt. Such a floor will deaden the noises made by a number of moving feet, which latter materially interferes with the clear propagation of sound.

The rise already advocated for the pit floor gives that portion of the audience a better view of the stage, whilst it brings them more in line with the horizontal sound-waves. In order that these latter may in no way be impeded in their progress under the first circle, this should be elevated as much as practicable above the pit floor. Valances hung from the soffits of the circles prevent by absorption the passage of sound-waves, whilst at the same time they intercept the sight.

To aid the speakers on the stage, every effort should be made to deaden all those extraneous noises arising from shuffling feet and locomotion. The form and covering of the auditorium ceiling is largely responsible for acoustic success, constituting, as it does, a species of sounding-board. The internal atmosphere naturally

ascends in a theatre, and the sound-waves, taking a like direction, impinge on the roof, and are either reinforced, conducted, or reflected according to the covering material of the ceiling. No reflection should take place from the ceiling. The sound proceeds horizontally from the voice, and if reflected at all, it should be in a similar direction. Cross action in the atmosphere is opposed to good acoustic effect. For this reason draughts are a source of indistinctness, by breaking up and diverting the sound-waves, whilst the maintenance of an equable temperature is essential to distinctness.

Ventilation for the same reason, when judiciously applied, may be made a powerful auxiliary in assisting the propagation of sound. To this end the fresh air inlets and exhausts should be so disposed that the internal atmosphere may move bodily and uniformly in one direction—preferably from the stage in the direction of the sound-waves. This will avoid those cross-currents which are at all times opposed to the free and uninterrupted transmission of sound.

A speaking-trumpet is the best form for conducting sound onwards with undiminished force. The auditorium should, therefore, be constructed with some approach to this formation, the sides converging towards the proscenium, or, in other words, expanding towards the back of the auditorium. The ceiling, as already pointed out, should follow the same principle of convergent lines and slope upwards from its junction with the proscenium wall, and be canted or coved at the side walls, or enclosing partition of the auditorium. Such a ceiling, if without projecting ornamentation, will assist the conduction of sound towards the gallery. Projecting ornament or raised decoration of any kind is undesirable when placed in positions likely to impede or break up the sound-waves.

It is absolutely necessary that an auditor should see a speaker, otherwise he will fail to hear distinctly.

It may be accepted as a test of the acoustic properties of a building that these are defective when a speaker experiences difficulty in speaking, for it is then quite certain that some of his auditors are hearing with difficulty.

In the selection of materials their properties must be duly considered, and their known influence upon the propagation, conduction, reflection, or reinforcement of sound carefully considered. Hard, smooth surfaces will invariably cause reverberation, to avoid

which, a roughened and slightly elastic material should cover them.

Too much drapery is undesirable: it always deadens the sound, but may be hung to prevent reflection.

Large air spaces, whilst desirable for the purposes of ventilation, are prejudicial to acoustic effect, the sounds being dispersed and lost. The auditorium ceiling should therefore err rather in too low than too great height, and for theatres of the size under consideration the height from the pit floor should not exceed 45 ft., and this can be easily accomplished when the ceiling is on the rake.

With the exception of the floor—which is frequently covered—everything in and about the stage is prejudicial to the accentuation of sound proceeding towards the auditorium. The large air space, the absorption by the cloths, borders, &c., and the strong upward current induced by the batten lights all tend to minimise the effect within the auditorium. It is therefore to this latter section of the theatre that the architect must give the most serious attention, yet how frequently is the skeleton interior handed over to the plasterer and decorator, and all acoustic excellence destroyed by every conceivable form of monstrous cornice, massive swags, and pendent excrescences from the ceiling!

# VENTILATION.

THE successful ventilation of a theatre can only be the outcome of careful and deliberate consideration. It can never be achieved by haphazard inlets and cowl-capped outlets. The most effective position for ventilating appliances can only be determined by an exact calculation of the amount of work each has to accomplish. Practical experience, coupled with the existing condition of theatres, justify the assertion that the satisfactory ventilation of such buildings is an undertaking of no little difficulty. Patentees of ventilating appliances affirm the contrary.

An examination of existing theatres tends to support the supposition that their architects have devoted little consideration to the means for ventilation, and displayed less faith in the inventions of patentees, or that they have wilfully refused to avail themselves of such appliances as are easily obtainable, and of acknowledged efficiency.

The air within a theatre will become deteriorated in less time than in any other building devoted to public assembly. To impose upon visitors the necessity to re-breathe the exhalations from other people's lungs is a disgrace to the management, an insult to the patrons, and a danger to the public. Good ventilation implies comfort, together with increased receipts. Defective ventilation implies discomfort and vacant seats. Fire and panic cannot claim so many victims as defective ventilation, hence an indifference as to the hygienic condition of theatres involves a responsibility that can only be realised by those who can form some conception of the terrible results that arise from non-conformity with the laws of health, in buildings devoted to public gatherings.

The authorities have endeavoured to reduce the probable recurrence of fire and panic in London theatres, yet the victims to defective ventilation and other insanitary conditions continue to perish without protest. It requires a holocaust to galvanise arm-chair reformers into activity.

The first principle of successful ventilation is *to discard half-measures.* Ventilate the entire building, by which means alone can an equable temperature and freedom from draughts be secured.

The auditorium, stage, passages, foyer, saloons, staircases, retiring-rooms, and dressing-rooms should be ventilated upon a uniform system, having the inlets and exhausts accurately adjusted to the amount of work they have to accomplish in their respective section of the building.

In estimating the quantity of fresh air required, the probable maximum number of the audience must be known, together with the most desirable quantity of fresh air required for each individual. With respect to the first requirement, the architect should add, say, one-third to the actual seating accommodation of his building, to allow for managerial packing. As regards the volume of fresh air required for each unit of the audience, the quantity has been variously estimated, and it is difficult to reconcile conflicting statements made by equally reliable authorities. At each normal act of respiration we draw in and expel about 40 cubic inches of air, leaving 290 cubic inches of air in the lungs. In addition to this 40 cubic inches, we can, by an act of the will, blow out 170 cubic inches additional, making the total quantity expired 210 cubic inches, leaving 120 cubic inches of air in the lungs, which *never* collapse.

Taking 18 as the average number of inspirations per minute, multiplied by 40, gives 720 cubic inches per minute, or 43,200 per hour. This equals 25 cubic feet.

Some writers base their calculations as to the supply of fresh air upon the abnormal inspirations, which are found to vary according to the stature of the individual. Thus, assuming a man 5 ft. 6 in. in height to give out 210 cubic inches of air at each full expiration, a man 6 ft. in height would give out 258 cubic inches by the deepest expiration, immediately following the deepest inspiration. Taking 230 cubic inches of air as representing the medium quantity at each full breath, multiplied by 18, the number of inspirations per minute, we have 2·39 cubic feet as the fullest measure, or about 144 cubic feet per hour. It has been stated that the expired air, mingling with several times its own quantity, deteriorates at each respiration about 2 cubic feet of air, or 2,160 cubic feet each individual per hour. Such a supply is only possible in the open air. In a small theatre it would be impracticable without creating draughts. Taking, for example, Her Majesty's Opera House, London, in which the void of the auditorium is large and spacious compared with the seating capacity, this result

could only be obtained by changing the atmosphere of the entire building fourteen times each hour. It has been authoritatively stated that the air within a building cannot be changed more than six times in an hour without causing inconvenience. When calculating the cubical air space provided, allowance should be made for the displacement by the audience, *e.g.*, Her Majesty's Theatre will seat 2444 persons. The approximate atmospherical capacity of the auditorium is 399,820 cubic feet, and the displacement by the audience--allowing 13 cubic feet per individual—equals 31,772 cubic feet, thus reducing the available atmosphere within the building to 368,048 cubic feet. This represents about 150 cubic feet per individual, or about half what the law demands for pauper dormitories, and one-fourth the cubical area required in English barracks. The obstacles to efficient ventilation in such a theatre as Her Majesty's are slight compared with the difficulties to be overcome in smaller theatres holding an equal number of persons. At the Vienna Opera House fresh air is supplied to an audience of over 3000 at the minimum rate of 900 cubic feet per hour for each person, the air entering at a velocity of 1 ft. per second. This comparatively slow speed may be accounted for by the fact that the area of the openings admitting the fresh air to the auditorium equals nearly 800 square feet. It has been asserted that the speed of the incoming air should never exceed 2 ft. per second, and $3\frac{1}{2}$ ft. per second has been given as a maximum. For the ventilation of a theatre such a rate of current would be utterly useless unless the inlets were so far increased in number as to be practically beyond proper control.

With many of the recently invented contrivances for supplying fresh air the air is injected into the building at a rate of current varying from 600 to 1,000 ft. lineal per minute. With such appliances the chief object must be to obtain a thorough diffusion, without creating local currents, and it is questionable whether it is desirable to attempt changing the atmosphere in small theatres more than three or four times in the hour. If the ventilation is adequately adjusted, a quantity of fresh air less than that theoretically prescribed will be found sufficient to maintain the atmosphere within a building in a state of comparative purity. The quantity of air has been variously estimated. Some authorities require 3 cubic feet, others 6 cubic feet for each individual, per minute. American and Continental authorities vary from a minimum of

10 cubic feet to a maximum of 30 cubic feet per minute for each individual.

In a theatre an endeavour should be made to supply a continuous influx of fresh air equal to *not less* than 4 cubic feet for each individual per minute. This should be regarded as a minimum. Applying this calculation to Her Majesty's Theatre, it will be found that 586,560 cubic feet of fresh air will have to flow into the building each thirty-seven minutes; or, in other words, the atmosphere of the building would require changing twice in each hour. To obtain an approximate result in a smaller theatre, the influx of fresh air would have to be considerably accelerated, and the changes more frequent. The foregoing calculation does not take into account the deterioration resulting from gas consumption, for which a further allowance must be made of three persons to each gas-jet, and from 5 to 7 persons extra for each Argand burner.

Where the electric light is used the deterioration to the air, arising from the source of illumination, is practically *nil*. To remove the vitiated atmosphere, and supply a pure air in its place a constant and uniform progressive movement of the internal atmosphere is necessary. To avoid confusion in the progress of the sound-waves, this movement should be in one direction—preferably, from the direction of the stage towards the back of the auditorium. For this reason, the fresh air might with advantage be admitted at the level of the box fronts, and egress for the foul air be provided at the back of each tier. Perfect ventilation is imperceptible, and the smaller the auditorium the more difficult will this be of attainment. If evidence were needed of the difficulties attending the satisfactory ventilation of theatres, it is to be found in the average temperatures registered in the galleries of London theatres, which vary from 70 deg. to 90 deg. Fahr.

Of the two methods of ventilation, the *vacuum*, or natural principle, and the *plenum*, or mechanical principle, the latter possesses certain advantages that strongly recommend it for the purposes of theatre ventilation. In the former method, the difference between the internal and external temperature is principally relied upon to maintain a constant influx of fresh air. Hence it follows that during the summer months this system is less reliable than during the colder seasons. To overcome the defects of the *vacuum* principle pure and simple, induced current ventilators are used at the upper part of the building, to create

a partial *vacuum*, and thus accelerate the inward rush of the outer air. The *vacuum* principle appears a natural and easy method, presenting no difficulties to its efficient working, yet it has been a signal failure in every theatre where adopted. Foul air will not pass out through shafts at the top of theatres unless drawn or propelled. When external appliances to produce a current within the extraction shaft are not used, the temperature of the air within the shaft must be raised several degrees higher than the air within the auditorium. This is assuming that the temperature of the external air is lower by several degrees than that of the internal atmosphere. Increasing the temperature of the air within the extraction shaft, decreases its specific gravity, induces velocity, and develops force. Hence it is that the sun-burner offers a ready and effectual means for ventilating the auditorium. Reliance should not be placed upon one central upcast shaft. Several should be provided, and distributed uniformly over the building, having exhaust cowls attached to each. The inlets should be in excess of the outlets, either in number or superficial area.

Fresh air should be admitted freely into the corridors and passages surrounding the auditorium, and numerous openings provided for the percolation of this air into the auditorium. A good plan is to convey the fresh air under the stagings of the tiers, and provide numerous small openings for its diffusion throughout the auditorium.

A theatre should be ventilated in sections rather than as a whole, and each tier provided with separate "inlets" and "exhausts." If practicable, each gas-jet should have a funnel-shaped receiver to carry off the products of combustion. This is done in some American theatres, and the same principle is applied to the footlights. However the fresh air may be admitted or foul air extracted, the object to be attained is the avoidance of the local currents and a *thorough diffusion* of the incoming air.

Warming the fresh air has been but little practised in this country, but cooling processes during the hot summer months are very desirable. At Her Majesty's Theatre provision is made for warming the fresh air admitted to the auditorium. An air-chamber is constructed in the basement, containing two Gurney's convoluted stoves. These are connected with an air-duct, 6 ft. by 4 ft., from

which upcast shafts, 18 inches square, convey the warmed air to the several tiers.

Warm air flues should be so constructed as to admit of easy inspection. For this purpose glazed stoneware pipes are the best. These are incombustible, of low conduction, and by reason of their smoothness do not retain dirt, and reduce friction to a minimum. However desirable means for warming the air may be in large theatres, the necessity for similar arrangements is not so imperative in theatres of the medium type. The heat given off by the bodies of the audience will suffice to raise the temperature of the air several degrees. The authorities generally object to methods of warming by hot air, preferring the hot-water systems, worked at low pressure.

Of the various systems of automatic or natural ventilation, that of Messrs. Robert Boyle and Sons, 64, Holborn Viaduct, is the most efficient. The following application of their system to an ordinary-sized theatre, accommodating about 2000 persons, is guaranteed to give satisfaction if fitted up by this firm.

For the extraction of the vitiated air from the theatre, they recommend a self-acting air-pump ventilator, 6 ft. diameter, having a 3-ft. diameter main shaft fixed on the ridge of the roof, immediately over the sunlight. A perforated opening, say 8 ft. diameter, should be made in the ceiling round the sunlight, and connected with the ventilator by means of an iron hopper and shaft, 3 ft. diameter. This will provide for the extraction of the foul air and products of combustion from the open part of the auditorium and front portions of the different galleries.

For the extraction of the vitiated air from the galleries, another 6 ft. diameter air-pump ventilator should be fixed on the edge of the roof at the back of the top gallery, and for a theatre in the course of construction eight flues should be made, 14 in. by 9 in., in the walls, placed at equal distances round the back wall of the auditorium, commencing at the gallery ceiling above the pit, and running up to the top of the walls, where they should be connected with the ventilator on the roof by means of 12-in. diameter galvanised iron pipes. Openings must be made into these flues immediately underneath the ceiling of each gallery, varying in dimensions according to the position of the gallery, so that, as nearly as possible, they may balance the quantity of vitiated air extracted from each gallery. The opening farthest away from the ventilator should

have an area equal to twice that of the opening nearest the ventilator. Where the theatre is already built, iron shafts fixed against the walls could be used in place of the flues, and treated ornamentally in the form of pilasters if desired. A 3-ft. diameter air-pump ventilator, with 18-in. shaft, should be fixed over the stage, to draw away the heat and products of combustion.

Fresh air may be admitted in various ways, but where free communication can be had with the external air, shafts or air-channels might be led underneath the floor, and the air from these admitted to the theatre through a tube or jacket placed round the pillars supporting the galleries, but carried up only two-thirds the height of the pillar, so that the fresh air would be delivered just above the head, on the vertical-tube principle. All the galleries might be treated in this way, by carrying small flat shafts underneath the ceilings or between the ceilings and the floors. Fresh air could also be admitted at the front of the galleries, through small tubes connected with shafts running round the galleries, underneath the ceilings, and communicating with the outer air. The air to supply all these shafts might be brought from two or three main channels and openings, or separate shafts to each, according as circumstances permit. The private boxes and stalls should also be fitted with vertical air inlet tubes.

It will be seen that the foul air is extracted from the backs of the galleries where it has a tendency to accumulate, and that the fresh air is admitted at the front, so that a certain portion of it must travel across the galleries before finding an exit giving the occupants a plentiful supply of fresh, cool air, without the slightest draught being experienced, owing to the minute and equable distribution of the air all over the theatre.

The advocates of the automatic, or natural, system claim several advantages for their method; viz., that it is always in action, independent of any attention; and that having no working parts, it cannot get out of order.

The first cost of the automatic system is also less than that of the mechanical, or *plenum*, method; but seeing that the efficiency of the automatic system is largely dependent upon external currents and the difference in temperature of the air within the building and the outside atmosphere, it is evident that at certain periods the automatic appliances are practically inoperative. At such times mechanical means alone will suffice to ventilate a theatre. With

the view to economise the cost of supervision, and reduce wear and tear to a minimum, a combination of both systems might be adopted with advantage.

For forcing fresh air into theatres there are several contrivances which may be highly recommended. The Æolus water-spray ventilator of the General Ventilating and Electrical Engineering Co., 124, High Holborn, London, W.C., is an appliance specially adapted for use in theatres. The influx of fresh air is well under control, and the action of the ventilator is altogether independent of external wind pressure or variations of temperature. This latter is an advantage possessed by all mechanical arrangements for ventilation, with the exception of such revolving cowls as are dependent on atmospheric currents for the motive power.

The following are some of the advantages claimed for the water-spray ventilator. The air within a building can be changed by direct influx or efflux at any desired rate, varying from 3000 to 500,000 cubic feet per hour. In summer the incoming air can be reduced 15 or 20 degrees, and by placing a small quantity of ice in the upper part of the apparatus a much greater reduction can be effected. A uniform temperature can be maintained throughout the building, varying from 55 deg. to 60 deg. Fah. In winter the air can be raised to any desired temperature by a gas stove attached to the apparatus. The air passed through the apparatus is thoroughly cleansed from impurities. There are no mechanical parts to get out of order, and no attention is required beyond turning the taps "on" and "off." The cost of the motive power, viz., water, is very small. A single gallon of water, at a pressure of 25 lbs. to the inch, will move 1000 cubic feet of air. The estimated cost of fitting up the Æolus water-spray system in a theatre, including the appliances for heating, cooling, and ventilating, is rather less than 5s. per sitting, the cost of water about £10 per annum, and the expenditure on fuel during the winter months about 2s. 6d. each twenty-four hours the apparatus is working.

The air-propeller of Messrs. Verity Bros., ventilating engineers, 127, Regent Street, London, S.W., is a suitable appliance for use in theatres. The propeller is driven by a jet of water, and as in the case of the Æolus spray ventilator, the required pressure may be derived either from a cistern, placed at the highest available point of the building, or direct from the main service. In either

case the fresh air may be drawn through tubes at points remote from the inlet—say 40 ft. vertically, and 60 ft. horizontally. This is a great advantage, permitting the air to be drawn from the purest source, and brought well into the interior of the building.

Where the power is available for driving, the Blackman air propeller is a most effective exhaust, and Wing's patent disc fan is also admirably adapted for ventilation. The latter is noiseless, and small power is required to use it. A 48-inch fan, driven by a 2-horse power gas-engine, will, it is asserted, move more than 1,000,000 cubic feet of air per hour.

The appliances at command for the purposes of ventilation are so numerous that it is impossible to enumerate them all, but the perfection and reliability of some are such that it is reprehensible not to adopt them.

Less attention has been devoted in this country to scientific ventilation than in America. At the Metropolitan Opera House, New York, the *plenum* method of ventilation has been introduced upon a scale unparalleled in this country. The plan adopted is by means of powerful fans to force a sufficient quantity of fresh air into the building to ensure an internal atmospheric pressure slightly in excess of the air outside the theatre, by which means an outward current is maintained through the foul-air outlets. Controlling valves are fitted to the entire system, which admit of a ready and easy adjustment of the currents. The Madison Square Theatre, New York, is ventilated upon a similar plan. "The inlet for fresh air is by a descending flue, which is 6 ft. square, lined with wood, and in this is placed a conical cheese-cloth bag, 40 ft. deep. This filters the air, which afterwards passes over ice in summer, four tons being used each night—two tons before, and two tons after the air passes the fan at the bottom of the inlet shaft. The fan forces the air into a brick duct, from which sheet-iron pipes lead the air into four brick casings, which surround the steam radiators used for warming the air in the winter. The auditorium has four sections of 90 seats each, and from the steam chambers direct to each of these seats a 4-in. tin circular pipe conveys the air. In addition to these, special ducts from the fan are used in the summer, to pour an extra supply of cooled air to various parts of the auditorium. All the gas brackets and chandeliers are encased in glass, and have special ventilating exhaust shafts. These shafts, in combination with others, draw off

the vitiated air from various parts of the house, by means of a fan in the roof. The footlights are also ventilated upon a similar system."

If it were once recognised by English theatre-builders how much the physical conditions of a play-house affected the spectators, improvement would soon follow. The intellectual appreciation of an audience bears a relative proportion to the degree of bodily comfort. Efficient ventilation, too, is a safeguard against fire, for in badly ventilated theatres the materials become dessicated and highly inflammable, a condition not compatible with the free circulation of the air. Whatever appliances are used for the purposes of ventilation, it is all-important that in a theatre these should be *noiseless*.

A large exhaust ventilator should be fitted over the stage, to draw off the smoke in the event of fire, and counteract the rush of air from the stage to the auditorium, largely due to the exhaust action of the sun-burner. Automatic arrangements have been suggested for opening the stage ventilator when the curtain is lowered, but such contrivances are useless. A powerful exhaust, continuous in its action, is preferable to intermittent ventilation, which causes draughts, and may at any time waft the hanging-cloths, borders, or gauzes against a gas-jet, and thus originate a fire.

The hap-hazard fixing of exhaust ventilators, without due consideration as to the means for supplying fresh air, is tantamount to courting failure. For this reason, appliances of acknowledged efficiency are frequently condemned when these fail to give satisfaction, owing to the conditions being unfavourable to their efficient working. An exhaust demands the provision of an adequate number of inlets: without these it is a useless contrivance.

# GAS-LIGHTING.

GAS, as a means of illumination in theatres, will no doubt retain its pre-eminence for some time, although the present method of applying it in public buildings is wasteful, unscientific, and inimical to health, when compared with the electric light. Gas in a theatre is a constant source of anxiety and danger. More than fifty per cent. of the fires occurring in theatres and opera-houses in the United States during 1885 were the result of gas explosions. Small escapes of gas cannot be altogether avoided when removing "battens," "ground," "pillar," and other temporary lights. The dangers attending the use of gas for stage illumination are increased in proportion to the fewness of the hands employed to manipulate it. The initial cause of many fires occurring in theatres may be traced to a reduction of the working staff. As an example of the large amount of gas consumed, and the consequent pollution of the atmosphere, mention may be made of the average nightly consumption of gas at the Princess's Theatre, London, during Mr. Wilson Barrett's tenancy—stage, 9000 ft.; auditorium, 8000 ft.; offices and corridors, 4000 ft.

Whatever system of lighting may be adopted in a theatre, whether gas or electricity, there should be a supplementary system of lighting by means of *oil lamps*. These should be freely distributed throughout the building, in such numbers that the audience would be well lighted during their egress in the event of the gaslight being suddenly extinguished. Sudden darkness in a theatre would create confusion and probable panic. It is therefore imperative that every arrangement should be made, and all reasonable precautions adopted, to render the total extinction of light well-nigh impossible. Yet in how few theatres is it possible to find the gas arrangements supplemented by any other system of lighting? notwithstanding that it has been demonstrated with terrible earnestness that a theatre lighted by one system only cannot claim an immunity from panic and disaster. Every gas-burner throws up a column of heated foul air This product of combustion is allowed to contaminate the internal atmosphere of the building, without any endeavour being made to discharge it direct into the external air. It is for this reason that

the sun-burner, which carries off the products of its own combustion, is so vastly superior to those irritating, sight-obstructing chandeliers that still adorn (?) some of our largest theatres.

The failure of the gas-lighting may arise from several causes, but chiefly in consequence of the insufficiency of the meters, which are frequently overtaxed. On special occasions extra lights are required, the gas for which is drawn from existing supplies without any regard to the capacity of the meters. It would appear desirable to have a reserve meter for use, in conjunction with those supplying the normal number of lights, during pantomime and other seasons when the consumption of gas is largely increased.

To provide for the failure of one or more meters, arrangements should be made whereby the supplies may be diverted from one section of pipes to another. A "switch" should also be fitted, whereby the gas may be diverted direct from the main into the supply pipes. Such a switch would be sealed by the gas company, and only used on emergency.

The gas-meters should be placed in a well lighted and ventilated chamber or vault, easily accessible from the "prompt."

The "cut-offs" for all the gas supplies should be fixed in the WATCH-ROOM.

At the "prompt" an index-plate should be fitted with the valves and by-passes for the stage lights, sun-burner, and dressing-room lights.

The supply to the following sections should be distinct and by separate meters: stage, auditorium, corridors, staircases and retiring-rooms, dressing-rooms, workshops and property-rooms.

It is desirable that the gas supply for the entrances, staircases, corridors, and retiring-rooms should be regulated and controlled from the WATCH-ROOM, when in the event of fire on the stage, there would be little probability of the auditorium lights being turned out in the confusion.

Where practicable, it is desirable to arrange the lights in corridors and staircases on a duplicate system, whereby alternate lights would be supplied from separate small meters. Such a method would increase the length of piping used, but would reduce the probability of extinction to a minimum.

It is important that all the lighting arrangements should be under the control of an experienced and reliable gas engineer, having an efficient staff of assistants. Every three months at least

the gas service throughout the building should be tested—*i.e.*, the escape of gas should be recorded during the day, when the main supplies are turned full on, and no lights burning. In some theatres the result will startle the management into instituting a thorough examination of all pipes, joints, taps, &c. Footlights, as usually fitted, are a terrible source of contamination to the atmosphere, stifling to the performers and irritating to the audience, more particularly to that portion occupying the pit and stalls.

The author has frequently suggested to gas engineers the desirability of inverting the Argand burners, and discharging the products of combustion downwards into flues connected with an extraction shaft. There exists no practical difficulty against this innovation, beyond reluctance to depart from stereotyped methods, and the manager who first introduces the improved footlights will set a fashion that will be quickly followed, whilst conferring a boon on his patrons and the actors. The arrangement here suggested is already in practical operation at the Grand Opera House, Paris. "An artificial draught is produced by a vertical shaft at one side of the stage, in which are fixed two or three rings of gas-burners. This shaft communicates with a horizontal draught-tube fixed below the foot-light burners on the stage. The horizontal gas-supply pipe passes below the draught-tube, supporting a series of small vertical branch pipes, which are arched over the draught-tube, and terminate in reversed burners, by which means the flames turn downwards from the top to the bottom of the glasses, and pass into the draught-tube. The entire products of combustion are thus drawn away to the outside air, leaving the stage agreeably cool. The artists and *danseuses* can approach close up to the footlight burners without the danger of their costumes igniting, however flimsy, as the rough plate which covers the burners is quite cool. Before the row of footlights are ignited, the interior burners in the vertical upcast tube are lighted to induce a draught sufficiently strong to draw the flames downwards." These draught-tubes might be further utilised for aiding the ventilation of the auditorium, and no doubt a water-spray would be as effectual in the exhaust-tubes as the rings of atmospheric burners.

With the view to minimise the great heat arising from gas illumination, it has been suggested that the auditorium, foyers, and reception-rooms should be lighted from above the

ceiling, which latter should be partially glazed. Hitherto this idea has not been regarded as sufficiently practical for general adoption. As an example of the successful application of this system, reference may be made to the gas-lighting arrangements of the House of Commons, the lighting of which is from above the ceiling, and through squares of ground glass 3 ft. in diameter. Above each square is a burner of the Argand form, having a hopper-shaped reflector over it, reflecting the light down through the glass into the house. A glass cove, running round the auditorium, having the gas-burners behind, could no doubt be made an effectual means of illumination. By an arrangement of skylights the cove could also be utilised for the admission of daylight, and by the use of tinted glasses the colour of the light could be made of the most agreeable character. Such a method of applying gas to the illumination of public buildings deprives it of many of the objectionable features at present associated with its use.

The judicious application of gas-lighting in public buildings may be made a powerful auxiliary in assisting the ventilation. Over every gas-jet should be fixed a funnel-shaped receiver, having attached a pipe, to carry off the products of combustion to the outer air. This arrangement is adopted in hospitals, why not in theatres?

For staircases and passages it is a good plan to place the lights in recesses formed in the walls, having the fronts glazed and fastened, and the supply of air, to feed the light, drawn from outside. By this arrangement it would not be possible for any mischievous member of the audience to tamper with the lights. Accidents have arisen from indulgence in such fool's freaks. No naked lights should be permitted in any part of the building. Glass globes may be used in the principal entrances, approaches to the stalls and dress circle ; but in every other part, without exception, wire globes or guards should be attached to all naked lights. These wire guards may be made far more ornamental and effective than ordinary glass globes.

All brackets should be stiff, and no jointed, swinging, or telescopic fittings used. The lights should not be fixed nearer than 3 ft. 6 in. vertically, and 2 ft. horizontally, to combustible materials ; but where these distances are not practicable, sheet iron may be fixed over the light, in such manner that a space is left

between the iron and the ceiling or other fixing, to allow the circulation of the air. Taps should not be fitted to gas-burners, but all lights should be manipulated with a key, so that only responsible persons can regulate them. Clusters of gas-lights fixed round the circle fronts cannot be recommended: in addition to vitiating the atmosphere, they are a nuisance to the people sitting in the front rows. Where used, the globes should be fitted with mica or majolica covers. Something akin to panic has been caused by falling programmes becoming ignited on the gas globes.

The auditorium should be "lighted up" thirty minutes before the admission of the public, to permit of a thorough inspection, and the lights should not be extinguished for at least fifteen minutes after the close of the performance.

When "lighting up," electric torches should be used in preferance to tapers or spirit cotton, and on no account should matches be allowed.

The whole of the gas-fittings should be of the best description, and iron pipes used throughout. Messrs. Strode and Co., Gas Engineers, 48, Osnaburgh Street, London, N.W., supply a pliable iron pipe, by the use of which the number of joints can be reduced, as the pipes may be bent without fracturing, which is not possible with ordinary tubing. The same firm have had a large experience in connection with theatre illumination, and their improved apparatus for lighting gas by electricity might with advantage be introduced into theatres. By its use, the evils attending the present methods of "lighting up" are entirely obviated, whilst the consumption of gas may be economised, as the whole system can be lighted simultaneously a few minutes before the doors of the theatre are opened to the public. In the event of sudden extinction of the gas-lights—from explosion or other causes—such a method for instantly relighting is very desirable. The varying pressure of the gas supply may result in an inferior light, and waste of gas. To secure the best results in light, for the quantity of gas consumed, it is essential that the gas should issue from the burner at a uniform, and comparatively low pressure. To secure this, Messrs. Strode and Co. supply a "gas regulator," which they assert has effected a saving in one building of nearly 40 per cent. Special attention should be devoted to the gas fittings on the stage, and it is advisable to have "pilot" lights to sun-burners,

border-lights, &c.; and, wherever practicable, to attach smoke consumers.

The manipulation of the moveable lights is a constant source of risk, whilst the methods at present in vogue for connecting the gas supply to wing lights, ground rows, hanging battens, &c., are not conducive to either safety or economy. To remedy some of the defects of the present systems, Messrs. Vaughan and Brown, gas engineers of Farringdon Road, London, have recently patented an ingenious and novel automatic water-joint, by the use of which the possibility of accidents is reduced to a minimum, as the insertion or withdrawal of the "dip" suffices to turn the gas on or off, as required. This water-joint is fitted at the Adelphi and Terry's Theatre, London. For the instantaneous lighting and darkening of the stage the "flash" burners fitted by the same firm, in combination with the ordinary lighting arrangements, may be strongly recommended. It is claimed for the "flash" system that by its use in connection with the battens, wing ladders, proscenium lights and floats, a saving is ensured in the consumption of gas equal to nearly 25 per cent. In connection with the stage index plate and suite of valves, Messrs. Vaughan and Brown have introduced a special "gas box," which ensures greater steadiness and regularity in the gas supply to the several sections.

The Wenham lamps, supplied by Messrs. Hersey, Bros., 70, Oxford Street, London, are now largely used in hotels, clubs, and business establishments, and their introduction into theatres and public buildings would materially reduce those risks at present inseparable from the use of gas as an illuminant. These lamps are exceedingly brilliant, whilst the consumption of gas is claimed to be 50 per cent. less than that of ordinary gas-light giving equal candle power. In addition to economy of consumption, and increased purity of light, the Wenham lights possess characteristics strongly recommending them for use in theatres. Like the sun-burner, these lamps are designed to carry off the heat generated at the point of combustion, and the light being enclosed in a strong glass shade, it is impossible for inflammable materials to come in contact with the flame. This light applied to battens and hanging lights would render gas lighting on the stage practically safe, and as little dangerous as electricity. Several places of entertainment have been fitted with this light, and it has been strongly recommended by the authorities for adoption in Parisian theatres.

The rules prepared for the regulation of the gas lighting in theatres by the Lord Chamberlain, the Metropolitan Board of Works and other authorities, are neither exhaustive nor comprehensive. The general provisions of these are as follows :—

"All fixed and ordinary gas-burners to be furnished with efficient guards. Moveable and occasional lights to be, where possible, protected in the same manner, or put under charge of persons responsible for lighting, watching, and extinguishing them. A separate and independent supply of light for the stage and auditory.

"No white metal gas-pipes to be used in the building ; all pipes to be made of iron or brass.

"The foot-lights or floats to be protected by a wire guard. The first-ground line to be always without gas, and unconnected with gas, whether at the wings or elsewhere. Sufficient space to be left between each ground line, so as to lessen risk from accident to all persons standing or moving among such lines.

"The rows or lines of gas-burners at wings to commence four feet at least from the level of the stage.

"Gas meters to be placed in well-ventilated chambers, and easily accessible."

Few as are these regulations, the number of theatres in which they are rigorously observed is equally limited.

It is desirable when fixing the stage lights that these should not be placed nearer to scenery or decorations of an inflammable nature than 18 in. horizontally, and 3 ft. 6 in. vertically, and when possible it is well to substitute tinted glass for the ordinary fabric mediums.

All lamps used in the supplementary system of lighting should be trimmed with the best colza oil, and should be hung on specially-designed brackets, fixed well out of the reach of the public. The accidental upsetting of a lamp has on more than one occasion caused both fire and panic in theatres. These dangers may be avoided by the using of the "Shaftesbury" safety lamps. A red lamp, having the word "Exit" in white letters on the globe, should be placed over each exit door.

The gas-lights within the auditorium should not be *lowered* for at least five minutes after the curtain has finally descended.

The use of gas-light in any part of the theatre during the daytime should be rendered altogether unnecessary by the provision

of the requisite windows. Gas-pipes should never be covered up, but always remain open for inspection. Meters should be placed within easy access from the prompt.

## Electric Lighting.

The electric light will, in the very near future, entirely supersede the use of gas as an illuminant in theatres, and, although this light cannot claim an absolute immunity from risks, these in no way compare with the evils arising from the use of gas. Having regard to the structural safety of the theatre, and the maintenance of the most desirable hygienic conditions within the building, preference must, undoubtedly, be given to the electric light. Gas, dependent, as it is, on combustion at the burner, is a source of impurity to the atmosphere and danger to the building, whilst, on the other hand, the incandescent electric light possesses all the health requirements of an artificial light, inappreciable heat, purity and brilliancy of colour, steadiness, and an almost absolute freedom from danger.

The risks inseparable from the electric light, *under certain conditions*, are in many instances the consequence of cheap installations and bad workmanship, rather than such as arise from the inherent defects of the system. To compete with other methods of illumination, electricity must prove itself equally reliable, and as easily manipulated. This it is acknowledged to be by those who have used it for the purposes here advocated. There is one advantage that gas may claim as against the electric light in respect to the aid which the former may yield in securing efficient ventilation. The electric light does not vitiate the internal atmosphere, but gas, by heating the air and thus giving ascensional force to the foul products of combustion and respiration, materially assists in their ejectment from the building.

The introduction of the electric light will not dispense with the necessity for ventilation. At a London theatre, where the electric light was installed and no special arrangements made for ventilation, the internal atmosphere became so stifling and vitiated, that it was found necessary to light the sunburner, in order to extract the foul air from the auditorium.

Owing to defective installation many fires have occurred since the introduction of the electric light, and upon this subject an eminent electrician has observed that "the steam-engines and their

boilers, or the gas-engines necessary for the production of the electric current, may very likely produce fire. But, besides this possible source, the special apparatus requisite for electric lighting is quite capable of producing fire unless it is constructed with the greatest care and knowledge. If the strength of the wires has been wrongly calculated, they may, under certain contingencies, grow red-hot. The lamps themselves, too, if improperly fixed, are likewise capable of being a source of danger. There are companies engaged in the extension of electric lighting who are only aiming to make it as cheap as possible, and are overstepping the limits which are necessary to safety. Still, when the necessary precautions are observed, electricity is certainly much less dangerous than any other mode of illumination."

The dangers incidental to the electric light may be rendered practically *nil* by having a good system of insulation, and to this end it is desirable to employ only firms of good repute to fit up the requisite plant, and, moreover, to seek the advice of a competent electric-light engineer. It is desirable that the electric power should be generated away from the theatre, as a steam-engine and dynamos within the building naturally constitute an extra element of risk. When the electric power is generated within the building it will be an advantage to have the accumulators charged during the day time, so that the noise of the engines and dynamos may not interfere with the performances. Gas-engines are practically noiseless. Accumulators in combination with the Swan incandescent lamps have worked with success at the Opera House, Paris. The incandescent light peculiarly adapts itself to the multifarious conditions of scenic illumination, as was demonstrated in a remarkable manner at the Opera House, Vienna, when experiments were made to test its suitability.

The installation consisted of 1236 incandescent lamps, and the following description of the effects obtained appeared in a newspaper :—

"The first scene showed a room in which broad daylight, produced by white lights, gradually turned into night with the aid of the whole of the lights. After this experiment, which went off with surprising steadiness, great interest was excited by the carrying of a candelabrum across the stage. The light was made to follow the same with a marvellous likeness to nature, and the effect of blowing out first one candle and then the other, and

subsequently relighting them, was very highly appreciated, as showing a complete command over the whole or partial illumination of the stage. After further experiments came a trial of costumes. About fifty "supers," male and female, crowded the stage—monks, pages, knights, hussars, priestesses, Egyptians, ballet-dancers, &c., in dresses of motley make and hue. The light showed up the costumes without the materials losing any of their brightness or gloss. After this trial the scene was changed, and experiments followed with landscape scenes. Bright daylight gradually changed to moonlight, succeeded by sunrise, deepening to morning glow; this lighting began at the cross battens, then flies, battens, and footlights, followed by a thunderstorm, with lightning. All these experiments went off without a hitch, and with the most perfect distribution of light."

As absolute dependence cannot be placed upon machinery in motion. There exists to this extent a possibility of failure, and the risk of sudden darkness when using the electric light. By the employment of "storage batteries," any danger from this source may be obviated, as the supply of stored electrical power is sufficient to carry on the lighting, should a break-down occur with the running machinery.

For use on the stage, the electric light is undoubtedly safer than gas: the conducting wires may be carried from point to point, and about the stage, with absolute freedom from risk. The cleanliness of the electric light is of itself a recommendation; and when in conjunction with this we find that matches, tapers, spirit-sponges, &c., are dispensed with, and that the only operation required to light up the entire buildings consists in the turn of a "switch," there should exist no hesitation on the part of managers in adopting this light.

In addition to the rules prescribed by electricians for the guidance of those installing the electric light, the English and American insurance offices have their own regulations, which in some instances are more arbitrary than protective. The following are some of the more important matters demanding special attention when fitting up the electric light: Continuous wires without joints should be used, having a sectional area that will allow 50 per cent. more electricity being sent through without heating than will be required for the lights supplied. Fusible plugs should be inserted at convenient points in each section of lighting. Without

these plugs an excess of electricity passing through the wires would heat them, destroy the insulation, and burn any combustible material in contact. Wires should not be fixed with metal nails against combustible substances. Many fires have occurred from neglect to use non-conducting fastenings. Wires should never touch, but for incandescent lights should be fixed 3 inches apart, and for arc lights 9 inches or 12 inches. The electric light and telephone conductors should be fixed apart. The wires should pass through dry places, and wires carried through floors or partitions should be protected against contact with metals or other conducting substances. All arc lamps should be protected by glass globes covered with wire, and enclosed at the bottom, to prevent particles of incandescent carbon falling. All wires should be arranged for easy inspection, and where passing through the exterior walls of buildings should be insulated and enclosed in pipes. When two wires are joined together the junction should be soldered or secured by a thoroughly clean binding screw or clamp. "Connections," "cut outs," and "resistance coils" should be placed in such manner that no danger can arise in the event of their heating. Whether the electricity is generated within the building or from an exterior source, a "shut off" should be provided in the WATCH-ROOM. The "switches" regulating the lights in the foyers, retiring-rooms, lobbies, corridors, staircases, and entrances should be fitted in the WATCH-ROOM. The electric lights should be turned on at least fifteen minutes before the public are admitted, and not extinguished for at least fifteen minutes after the close of the performance.

Danger to individuals is practically impossible where only incandescent lamps are used, and reasonable care will prevent any risk from the use of the arc lights.

The following rules and regulations for the prevention of fire risks arising from electric lighting have been prepared by a committee appointed by the Council of the Society of Telegraph Engineers and Electricians, and the names of those serving on the committee are a guarantee as to the practical value of the suggestions :—

# RULES AND REGULATIONS

## For the Prevention of Fire Risks arising from Electric Lighting,

Recommended by the Council in accordance with the Report of the Committee appointed by them on May 11, 1882, to consider the subject.

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### MEMBERS OF THE COMMITTEE.

Professor W. G. Adams, F.R.S., *Vice-President.*
Sir Charles T. Bright.
T. Russell Crampton.
R. E. Crompton.
W. Crookes, F.R.S.
Warren de la Rue, D.C.L., F.R.S.
Professor G. C. Foster, F.R.S., *Past President.*
Edward Graves.
J. E. H. Gordon.
Dr. J. Hopkinson, F.R.S.
Professor D. E. Hughes, F.R.S., *Vice-President.*
W. H. Preece, F.R.S., *Past-President.*
Alexander Siemens.
C. E. Spagnoletti, *Vice-President*
James N. Shoolbred.
Augustus Stroh.
Sir William Thomson, F.R.S., *Past-President.*
Lieut.-Colonel C. E. Webber, R.E., *Past-President.*

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These rules and regulations are drawn up for the reduction to a minimum, in the case of electric lighting, of those risks of fire which are inherent in every system of artificial illumination, and also for the guidance and instruction of those who have, or who contemplate having, electric lighting apparatus installed in their premises.

The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing," or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the dangerous production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are either ordinarily or for the purpose of testing, passed through the circuit. Should wires become perceptibly warmed by the ordinary current,

it is an indication that they are too small for the work they have to do, and that they should be replaced by larger wires. Bare or exposed conductors should always be within visual inspection, and as far out of reach as possible, since the accidental falling on to, or the thoughtless placing of other conducting bodies upon, such conductors would lead to "short circuiting," and the consequent sudden generation of heat due to an increased current in conductors not adapted to carry it with safety.

The necessity cannot be too strongly urged for guarding against the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger.

The chief dangers of every new application of electricity arise from ignorance and inexperience on the part of those who supply and fit up the requisite plant. The greatest element of safety is therefore the employment of skilled and experienced electricians to supervise the work.

### I. THE DYNAMO MACHINE.

1. The dynamo machine should be fixed in a dry place.

2. It should not be exposed to dust or flyings.

3. It should be kept perfectly clean and its bearings well oiled.

4. The insulation of its coils and conductors should be practically perfect.

5. All conductors in the dynamo-room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

### II. THE WIRES.

6. Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left it cannot permit of a permanent arc or of heating.

7. Every part of the circuit should be so determined that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and all junctions with a smaller conductor should be fitted with a suitable safety fuse or protector, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150° F.

8. Under ordinary circumstances complete metallic circuits should be used. The employment of gas or water pipes as conductors for the purpose of completing the circuit should not in any case be allowed.

9. Bare wires passing over the tops of houses should never be less than seven feet clear of any part of the roof, and all wires crossing thoroughfares should invariably be high enough to allow fire-escapes to pass under them.

10. It is most essential that joints should be electrically and mechanically perfect and united by solder.

11. The position of wires when underground should be clearly indicated, and they should be laid down so as to be easily inspected and repaired.

12. All wires used for indoor purposes should be efficiently insulated, either by being covered throughout with some insulated medium or, if bare, by resting on insulated supports.

13. When these wires pass through roofs, floors, walls, or partitions, or where they cross or are liable to touch metallic masses, like iron girders or pipes, they should be thoroughly protected by suitable additional covering; and where they are liable to abrasion or to the depredations of rats or mice, they should be efficiently encased in some hard material.

14. Where indoor wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the apparatus and circuits cannot be too strongly urged. The escape of electricity cannot be detected by the sense of smell, as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering, by electric action.

### III. LAMPS.

15. Arc lamps should always be guarded by proper lanterns, to prevent danger from falling incandescent pieces of carbon and from ascending sparks. Their globes should be protected with wire netting.

16. The lanterns, and all parts which are to be handled, should be insulated from the circuit.

## IV. DANGER TO THE PERSON.

17. Where bare wire out-of-doors rests on insulating supports, it should be coated with insulating material, such as indiarubber tape or tube, for at least two feet on each side of the support.

18. To secure persons from danger inside buildings, it is essential so to arrange and protect the conductors and fittings that no one can be exposed to the shocks of alternating currents of a mean electro-motive force exceeding 100 volts, or to continuous currents of 200 volts.

19. If the difference of potential within any house exceeds 200 volts, the house should be provided with a "switch," so arranged that the supply of electricity can be at once cut off.

# THE PREVENTION OF FIRE.

A THEATRE badly constructed is the most dangerous of all public buildings. The primary consideration should therefore be to build a theatre in the most substantial manner, and with materials that will not aid combustion. Secondly, all fittings, furniture, scenery, and wardrobes, and all properties made of combustible materials, should be coated periodically with an anti-ignition solution. Thirdly, an efficient "fit up" of fire appliances should be provided, having a plentiful supply of water; and arrangements should be made for the maintenance of a systematic inspection, or FIRE WATCH, together with periodical fire drills.

In order to fulfil the first requirement of theatre building, it is requisite that each section be separated by means of vertical and horizontal fire-resisting divisions, and these divisions should be as frequent as the practical working of the building will permit This necessity was pointed out by Saunders, in his treatise on theatres, published in 1790, yet it has only been partially enforced within the past few years. "Theatres," he observes, "should be surrounded by a thick wall all round the stage and auditorium. Over the curtain an arch may be turned, on which the wall may be continued up through the roof, so as to prevent all connection of the timbers. The passages communicating with the boxes should all be arched, and have an easy access to spacious stone staircases, that would in case of fire enable the audience to depart without the least hazard; and though it is necessary to confine the entrances to a few in number, yet there ought to be many large doors hung on the outside, ready to be thrown open at the conclusion of the performance and upon sudden alarm. Partition walls should be carried quite through the roof, in as many places of the building as opportunities afford, and no one would neglect to render it insulated where possible." Had theatrical architects carried out the method here suggested, the world would not periodically be horrified by the details of a human holocaust.

In selecting the materials wherewith to build a theatre, it is essential to choose such as are *least affected by heat;* not only of actual conflagration, but the constant high temperature generated by gas illumination. Experiments as to the conductive power of

various building materials have demonstrated that brick, wood, and plaster are the least affected by high temperatures. Architects are beset with difficulties in the selection of materials when desirous of building theatres on approved fire-resisting principles.

In all enactments relating to fire-proof construction, stone and iron are mentioned as the most desirable materials, whilst, in opposition to the decree of the Legislature, we have the practical experience of the chief officer of the Metropolitan Fire Brigade, who asserts that in all large fires "bricks are uninjured; wood seriously damaged, but only partially consumed; iron fractures, and is consequently rendered worthless," and that "stone is shivered into fragments and totally destroyed." Hence, from observation, it has been proved that some combustible materials possess better fire-resisting qualities for *constructive purposes* than materials that are non-combustible.

The fire at Clerkenwell, London, which destroyed two-thirds of a parish, demonstrated the reliability of flitch-beams when exposed to fire. The timbers were only charred sufficiently to form a protecting skin, effectually excluding oxygen from the inner parts, and so preventing the flitches from twisting. Beams of this description, having the timbers chemically treated and further protected by a coat of plastering, may be relied upon to withstand the action of fire better than iron girders of equal strength, even when the latter are similarly protected. Wood in construction is only really dangerous when of small scantlings, but when in baulk and of the harder descriptions it is more reliable than iron. A wood beam will withstand a powerful dead heat upon its sides for an indefinite period without igniting, unless a transverse section of the fibre is exposed to the fire. Wood beams of large scantlings, used either as posts or girders, and protected with a coat of suitable plaster, will probably give the nearest approach to practical fire-resisting construction.

Hitchin's patent plastering, supplied by the Hitchin's Fire-proof Plastering Company, 1, Gresham Buildings, Basinghall Street, is a protective material of great value for covering timbers, ceilings, walls, and for the composition of the general enrichments of a theatre. Experiments of a very severe nature have proved its value as a fire-resisting substance. It can be made in large slabs, which are readily fixed to the soffits of floors or other woodwork by means of ordinary screws. All large fires have

demonstrated the unreliability of iron and the comparative reliability of wood, which latter, when protected as described, becomes a material non-combustible and but little affected by the continuous application of heat.

The destruction that follows in the event of a fire from the use of unprotected ironwork cannot be too strongly emphasised. Its power of conducting heat is 150 times greater than that of fir, and at the temperature of boiling water cast iron is stated, on reliable authority, to lose 15 per cent. of its strength, and at a temperature of between 600 deg. and 700 deg. Fahr.—a degree of heat just sufficient to melt the lead seatings of girders and columns—it has been known to fail time after time, although the fusing-point of this metal is 2912 degrees Fahr. At the burning of the Alhambra Theatre, London, iron plate girders, 3 feet deep, were twisted like ribbons.

For the formation of partitions, private box divisions, and dressing-room partitions, and in all places where a fire-resisting wall is required and space is valuable, the system of constructing walls, patented by Messrs. R. Johnson, Clapham, and Morris, of 26, Lever Street, Manchester, is well adapted. The wood framework of an ordinary partition-wall is replaced by an ingenious but simple combination of hoop and angle iron, so designed that the maximum strength is secured, with a minimum weight of metal. This framework is covered with galvanised wire netting, $\frac{3}{4}$-in. mesh, finished with ordinary plastering on both sides, which forms a wall as incombustible as brick, though much lighter, and only 3 inches and 4 inches thick.

Monolithic, or concrete building, is a desirable method of constructing theatres, and it is a matter for surprise that this system does not meet with more favour. Ordinary concrete, as usually made, is not a satisfactory fire-resisting material, but when prepared with good cement, and aggregates that have been previously calcined, it constitutes one of the best materials for the construction of walls, floors, and staircases ; and where the distances between the supporting walls do not exceed 8 feet, no stiffening nor supporting ironwork is necessary.

Iron and concrete in combination are largely used for the construction of fire-resisting buildings, but the relative value of the several systems in vogue is in proportion to the low conduction of the material encasing the ironwork. The system of fire-resisting

construction introduced by Messrs. Dennett has been subjected to severe tests, with the most satisfactory results. Their concrete is specially prepared with gypsum, the heat-conduction power of which is less than that of brick. In Paris, where gypsum abounds in the neighbourhood, the floors and partitions of buildings are filled in between the woodwork with this mineral, and as a result of the adoption of this method of construction, it is rarely that a building is burned down in that city.

Regarded as a fire-resisting material, stone cannot be recommended for staircases and landings. Sandstones are the best; being composed largely of silica, they require intense heat to produce fusion, whilst limestones and igneous rocks disintegrate at comparatively low temperatures. Artificial stones, which are composed chiefly of alumina and silicate of lime, will withstand the effects of prolonged fire.

Stone staircases have frequently broken at their junction with the supporting walls when subjected to high temperatures, without actual contact with flames; and it has been asserted by Captain E. M. Shaw, in his *brochure* on "Fire Surveys," that stone "is utterly and entirely inadmissible" for the construction of fireproof staircases, for "it yields to the effect of fire more rapidly than almost any other material commonly used for building."

When deciding upon the most desirable method of fire-resisting construction, the question to be settled is not so much the combustibility or otherwise of the various building materials, but which of them will resist the action of *continuous heat for the longest period with the least injurious effects.* Iron, although not combustible, has destroyed many buildings by its expansion and sudden contraction or failure on the application of water. When the architect is permitted an unfettered choice in the selection of materials, he should not hesitate to construct his building with suitable concrete and protected timbers, in lieu of the ordinary combinations of iron.

A floor constructed with solid wood joists, nailed together and chemically treated, having the soffit protected with Hitchin's fireproof plaster or other similar substance, and the flooring grooved and tongued and nailed close, would withstand the fiercest fire for an indefinite period, without in any degree affecting the structural stability of the walls.

All roofs should be *flat* and of fire-resisting construction, covered with asphalte or other incombustible material.

The building should be kept as low as possible, when in the event of fire it will be better under control. Captain Shaw affirms that the cube of 60 ft. is the largest capacity that can be protected with reasonable hope of success. (See "Suggestions for a Safety Theatre.")

The danger of fires in theatres arises probably more from the nature of the contents than from the lack of fire-resisting construction in the building itself.

Having constructed the theatre on the most approved principles, it is imperative that the contents be rendered practically uninflammable. All scenery, canvas, gauzes, mediums, wardrobes, decorations, and enrichments liable to ignition from contact with gas flames should be coated with an anti-ignition solution. Several solutions are now in use, which, when applied to combustible substances, render them uninflammable. Of this kind are cyanite, asbestos paint, pyrodene, Blane's solution, and tungstate of soda, the latter being a protective salt, well suited for laundry purposes. It is a matter for regret that inventions of this kind do not find more favour both with the authorities and managers of theatres. Protective solutions make no show, hence more attention is devoted to the appliances for extinguishing fires than to the means for their prevention. Where one appliance is invented for preventing fires a dozen exist for extinguishing them.

"Cyanite," manufactured by the Patent Fireproof Cyanite Company, Paulton Square, Chelsea, is a material that may be used as an ordinary paint, a staining preparation, or a colourless protective solution. "Cyanite" has been subjected to very crucial tests, and its undoubted value as a fire-resisting solution, suitable for application to woodwork, scenery, and fabrics, is proved by the strong favour accorded to it by Captain Shaw, C.B., chief of the Metropolitan Fire Brigade. The fire offices have also recognised its value, and in a few notable instances have made the application of cyanite a condition of insurance. One very essential advantage claimed for cyanite is that the solution—unlike other fireproof paints—not only acts as a substitute for ordinary paint, but it penetrates into the pores of the wood to an appreciable extent, so that when once applied it cannot chip off, and requires no re-applications. A special preparation of "cyanite" is now made,

suitable for scenery, fabrics, and wardrobes. The most delicate silks and satins may be made uninflammable without the slightest injury to the colour or texture, and the price charged renders it possible for the most impecunious manager to secure a comparative freedom from fire risks.

Many of the automatic inventions for preventing fires are merely ingenious toys, the successful working of which are subject to certain conditions and circumstances that cannot be guaranteed to occur in combination. Further, their action depends upon the existence of the very evil they are designed to avert.

The most desirable of the many forms of automatic appliances are probably the "Grinnell Sprinklers," so largely used for the protection of American mills. These "sprinklers" are generally fitted a few inches below the ceiling, and are started by the fusing of a composite plug or link, which may be tempered to withstand any required degree of heat. Each "sprinkler" is capable of protecting an area of 100 square feet, and they are usually tempered to *open* when the temperature attains 150 degrees Fahr.

The normal conditions within a theatre are altogether different from those within warehouses and cotton mills, for the protection of which "sprinklers" were originally invented. In warehouses the "sprinklers" are fixed at the ceiling, and are rarely more than 10 feet or 15 feet from the floor or point of conflagration. In theatres, however, the "sprinklers" would be fixed to the soffit of the gridiron—a height varying from 40 feet to 60 feet above the stage floor—and it is reasonable to assume that some time would elapse after the outbreak of fire, at the lower parts of the stage before the "sprinklers" would come into operation.

A modification of the "sprinkler" system has recently been fitted at Terry's Theatre, London, by Messrs. William Rose and Co., fire engineers, 145, Cannon Street, London, E.C., and Manchester, in which the automatic arrangement for starting the shower is superseded by human agency. The "sprinklers" are fitted to the soffit of the stage roof about 7 feet apart, and fire valves are attached to an index plate at the stage level, by means of which the fireman or other employé can regulate the flow of water into the several sections of the "sprinkler" installation. Thus, in the event of fire only that part of the stage or section of the building in which the outbreak occurred would be deluged. The "sprinklers," when in action, throw up a powerful jet of water, which, impinging on the

ceiling, is spread out in its descent upon the fire. The foregoing arrangement possesses self-evident advantages to recommend it: the "sprinklers" cannot come into operation except on the occurrence of real fire; the appliance is under perfect control, permitting the water damage to be localised; and the tests upon actual fire on the stage permit no reasonable doubt as to the efficacy of the system. In one Continental capital shower pipes are compulsory for extinguishing fires on the stage.

Some few years ago the author suggested the following arrangement, which, whilst under local control, possesses advantages over the "sprinklers"—greater force, and more equal pressure over the protected area.

Attach perforated tubes, 2 inches in diameter, to the soffit of the gridiron floor, and divide this arrangement of pipes into nine sections, as below :—

| | | |
|---|---|---|
| O. P. BACK. | BACK. | P. BACK. |
| O. P. CENTRE. | CENTRE. | P. CENTRE. |
| O. P. FRONT. | FRONT. | P. FRONT. |

PROSCENIUM OPENING.

The valves to govern the several sections to be fitted to an index plate at the prompt, having the nine divisions marked as above. The water for these shower pipes could be supplied from a tank, independent of the other supplies for extinguishing appliances, and could further be charged with carbonic acid gas.

"Hand grenades," judging from the brave show made in some theatres, appear to be finding favour with managers. They are intended to put out fires in their incipient stage, and to supersede more cumbrous appliances. Few persons could throw a grenade with precision when excited by the presence of fire; it is therefore essential that practice in grenade-throwing should constitute a part of the fire drill. Of course the glass receptacles would be charged with water for this purpose, in lieu of the chemical compound.

Whatever fire-extinguishing appliances may be fitted in a theatre, these should be of such a nature that in the event of fire the protective measures would be entirely independent of external aid. The Metropolitan Fire Brigade could not reach any London theatre within fifteen minutes of an outbreak of fire, and in the majority of cases a longer time would elapse. Provincial theatres are probably even less favourably circumstanced in this respect.

Fires, whether large or small, require to be attacked not only with water, but with *intelligence of a special order*. For this reason it is false economy, a deception and a snare, bordering on moral criminality, to put a nonentity into a uniform and call him a FIREMAN. A staff of *practically trained* firemen and employés; an efficient fit-up of fire-extinguishing appliances; and a building constructed on fire-resisting principles, having all the contents rendered uninflammable by the application of anti-ignition solutions, would justify a claim of practical immunity from risk of fire.

Every theatre should be fitted up with a double set of fire-extinguishing appliances—one set supplied from the town main, and the other from tanks elevated above the highest points of the building. These tanks should contain at least 1000 gallons of water for each hydrant supplied, and the contents should be used for fire purposes only. As a guide to assist in determining the height of these tanks above the building, an authority observes that "the number of pounds pressure per square inch at the nozzle is somewhat less than half the number of 'feet head' of water in the pipes; fifty feet head of water give 21·68 lbs. per square inch, and this is the lowest serviceable pressure." The highest pressure attainable in London theatres is about 55 lbs. per square inch. It is worthy of comment that until very recently one of the most popular of metropolitan theatres boasted a maximum pressure of 20 lbs. on the stage, and 1½ lb. in the flies and gallery.

When fitting up fire appliances it is desirable to engage the services of a practical fire engineer, to advise as to the number and position of the hydrants, size of mains, branch pipes, and nozzles. Fire mains should never be less than 3 inches in diameter, and should be coated with a composition to prevent rust. All bends and tee-pieces should be made so as not to retard the flow of the water. Mains should be of sufficient strength to withstand the internal pressure, also the shocks occasioned by the sudden opening

or closing of the valves. Hydrants should be protected from the frost, and made to open easily and quickly. Only the very best and most approved descriptions should be used—these in the end are the cheapest. The kind of hose used is a matter of the most vital importance. For economy and efficiency, "there is nothing like leather." Leather hose will, with care, last twenty or thirty years, whilst its sweating properties when in use protect it from damage by fire. No other kind of hose can be effectively repaired. Rubber-lined hose, on the other hand, has no joints, is cleaner, requires less attention, but being externally perfectly dry whilst in use, is liable to be damaged by flames and burning embers. It is further liable to rot or mildew, and the indiarubber lining soon deteriorates, but whilst in good condition it possesses the quality of reducing the internal friction to a minimum. The adoption of rubber-lined canvas hose by the Metropolitan Fire Brigade, in lieu of leather hose, has not met with the approval of the fire insurance offices. The size of the nozzle at the end of the branch pipe should be carefully adjusted to its position in the building and the pressure and quantity of water. The same nozzle will not be suitable for the top and bottom hydrants of a fire main if the best results are desired from the pressure of water. English and American experts are considerably at variance with respect to the most efficient size for the nozzle, the former authorities asserting emphatically that the nozzle used by the English Fire Brigades is altogether too small. Captain Shaw, however, claims for his attenuated streams results that will compare favourably with the larger quantities of water projected on to American fires.

The hydrants supplied from the mains and the tanks should, when separate, be fitted up alternately, and the distance from any two tank hydrants or two main hydrants should never exceed 100 feet horizontally. Hydrants should be fitted to each floor or section of the building, without exception. In cases where the tank hydrants are not independent, but provision is made for turning the tank supply on to the main hydrants, the horizontal distance between the hydrants should not exceed 60 feet. Hydrants are too frequently fixed with the view to display rather than efficiency. These should be so arranged that, in the event of fire, the firemen may manipulate the hose for the longest possible period whilst ensuring their escape, and in no case should they be incommoded by the egress of the audience. No system of fire

appliances can be considered satisfactory unless jets of water can be commanded capable of reaching every combustible point of the building.

Where there exists a deficiency in the water pressure, Merryweather and Sons' "pressure augmenter" may be used with advantage. This useful contrivance is a kind of hand-pump, secured to the floor, and connected with the supply and delivery hose. By its use a powerful jet of water may be obtained where no adequate water pressure exists, or even when level with the supply.

Not less than two hydrants should be fitted on each tier—on the stage, mezzanine, fly galleries, and the roof of the theatre. Forty feet of hose should be attached to each hydrant, "flaked" against the wall, and the branch pipe and nozzle fixed ready for use, so that in the event of an emergency the fireman has merely to turn on the water, lay hold of the branch pipe, and run to the point of conflagration—the hose "unflaking" as he recedes from the hydrant. In addition to the hydrants, hand-pumps should be placed on each tier, the stage, fly galleries, mezzanine, and in each separate section of the building, together with a number of fire buckets for filling them. The hand-pumps are fixed in a cistern or bucket, holding six gallons of water. By means of this portable appliance a powerful jet of water can be projected thirty or forty feet.

The fire-buckets should be kept filled with water, and hung upon brackets in sets of four or six. Buckets upon brackets are not liable to be upset, neither can one be removed without at once attracting notice. Near the buckets a draw-off tap, with waste sink, should be provided for filling. Sand buckets, filled with earth or sand, should be kept in the lamp-room. On the stage at the P. and O. P. sides, buckets filled with water, and a small tank containing sponges and blankets, should always be in readiness, whilst firemen's axes and hooks for cutting down scenery should be placed on the stage and in the fly galleries.

As a further precaution, chemical "extincteurs" and "grenades" may be distributed about the building, although these contrivances should not take precedence of more legitimate and more reliable appliances. "Extincteurs" can only be used once, and are frequently placed in buildings without a second chemical charge being available.

During a performance two firemen should be on the stage, two others patrolling the building, and one other on duty in the WATCH-ROOM. A fire patrol should be instituted whereby each section of the building will have to be traversed constantly during the day and the night.

In lieu of "tell-tale clocks" or similar contrivances, there should be substituted electric buttons, fixed at as many available "station points" as practicable, which, when pressed, shall sound a single stroke bell in the WATCH-ROOM, and record, by means of a self-registering apparatus, the performance of the duty. A code of signalling should be arranged between the firemen patrolling and the WATCH-ROOM. (See p. 131.)

The fire appliances should be examined every day; and once each month, at least, the firemen and employés in the theatre should be instructed in the use of the fire appliances by an officer of the local fire brigade.

The duties of firemen are briefly enumerated elsewhere (see p. 124), and on no account should they be employed upon other than their legitimate work. It has been suggested that firemen having charge of public buildings should be tested as to their mastery of smell and capability to detect the odour of combustion, ailure in which may prevent the discovery of an incipient fire until it has assumed the proportions of a conflagration. Firemen should not be allowed on night duty when suffering from cold in the head or other disabling affection. Under certain physical conditions a fireman's nose may be perfectly dead to the fume-signals of fire or the odour of gas-escapes.

The employés should not only be periodically drilled in the use of the fire-extinguishing appliances, but instructed how to act in the event of panic, arising from causes real or imaginary. The fire-drill, whilst being practical, should also provide for a degree of theoretical instruction. It is desirable that every employé should know that 10 per cent. of the water thrown upon a fire is invariably converted into steam, and that this percentage may be increased by permitting the jet to descend upon the fire *through the flames;* that the steam thus generated causes the atmosphere to rush under the burning material and supply oxygen to the fire; that by playing direct upon the lower part of the fire, the steam thus generated may become a powerful auxiliary in subduing the fire; that steam so generated displaces the fire-sustaining atmosphere,

and the flames are soon put out; that any quantity of water converted into steam will displace 72,000 times its own bulk of fire-sustaining atmosphere.

A WATCH-ROOM should be arranged and fitted as the head-quarters of the life-saving and property-saving organisation. In this room one fireman should always be on duty night and day. (See p. 47.) The chief fireman should take immediate command of the entire working staff in the event of fire, and the success of their efforts will depend chiefly upon the practical training they have received.

Writing on the subject of fire-drills in theatres, an authority observes that "it is contrary to all experience to find a man, however intelligent, suddenly developing at a critical moment so complete a power of command that those who have never obeyed him, or perhaps any one before, will be certain instantly to obey; and here the principal danger lies in the case of an *unskilled* man, as the slightest hesitation, awkwardness, or error on his part is certain at once to turn him into an object of contempt or ridicule, in which case his authority would instantly be at an end." Theatre proprietors should ever remember that promptitude and coolness in an emergency can only be expected from those who are thoroughly proficient in the handling of the fire appliances.

Every part of the theatre roofs, whether flat or otherwise, should be connected by iron ladders. Two or more iron ladders should also be fixed against the external walls, near a vertical line of windows, for the use of the brigade firemen. Precious minutes are lost, waiting for fire-escapes and ladders.

External hydrants should be provided, enclosed in wood cases containing the hose and other appliances. A good position would be at the ground level near the fixed iron ladders. The hose attached to the external hydrant should be of sufficient length to reach to the top of the building.

All fire appliances, of whatever description, should be of the local fire brigade pattern.

Lightning conductors should be fixed to the highest points of the building, and all metallic spouts, gutters, and other masses of ironwork should be electrically connected with the conductors.

The following notes have been prepared by Messrs. Merryweather and Sons, the eminent firm of fire engineers, 63, Long Acre, London, W.C.:—

"In designing an arrangement of fire appliances for a theatre, the greatest prominence should be given to a liberal supply of hydrants, placed with judgment, not only with a view to the fireman getting to the fire, but also that he may get away from it. It is useless to place a hydrant in such a position that a man using it would not be able to leave his post quickly, if driven back by the heat or flames. Hydrants judiciously placed, and branch pipes promptly used, are sure and powerful weapons, providing there is a good water supply.

"Hydrants should be placed behind the scenes on each side of the stage, on each floor level, and one should be placed close to the stage door, also any other doors leading outside or into the auditorium.

"In the front of the house hydrants should be placed on each floor as close to the staircase as possible, having a sufficient length of hose provided to cover all parts of the building.

"An adjustable nozzle, that will either throw a plain or a spray stream at the will of the operator, is a valuable addition to a branch pipe.

"When tanks are fixed, affording but a low head of water, or the pressure in the main is low, a Merryweather's pressure augmenter may be used with advantage, or in towns where high-pressure hydraulic mains are laid down this water may be used to actuate a Merryweather's hydraulic pump. As a means of quickly throwing water on a burning cloth, application has recently been made for a patent for fixing pipes across the stage, furnished with copper nozzles of special construction, the water supply to which is controlled by a valve placed close to the stage door, so that in the event of a cloth catching fire the whole of the stage can be deluged in a few seconds. Hand-pumps and buckets, kept full of water, should be distributed at all available points, but any appliances smaller than these should not be provided; for although apparently great results are attained in the advertised public displays of these, a real fire would figuratively laugh at them.*

"With reference to water curtains, the plan that seems to give

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* Hand grenades are, no doubt, the appliances here referred to. Many startling rumours are current with respect to these contrivances. The manufacturers of grenades should not fail to produce the most convincing proofs that the fumes arising from the chemicals used—when thrown upon a fire—are in no degree dangerous to human life.—J. G. B.

the best promise of success is a double canvas curtain—virtually a water-bag—prevented from bulging by being riveted together at intervals, having water-pipes laid across the top, by means of which it could be quickly filled whilst being lowered.

"An audience, in entering a theatre, would no doubt feel more secure from fire if they had some assurance that the fire appliances were in working order, and the water-supply to be depended on. In view of this, a patent has been applied for by Mr. J. Compton Merryweather, for a device to be fixed in a conspicuous place in the vestibule, consisting of an indicator which will show when the water is *on*, but if *off* will indicate '*Water off—Danger*,' and an electric bell will ring continuously, as a warning. It is proposed to enclose this apparatus in a locked box, beyond the control of the manager, but in charge of the municipal or other authorities"

# INSURANCE.

THE average life of a theatre in the past has been about twenty-one years, but the science of building construction has rendered it possible to considerably increase this average. Erecting a theatre on fire-resisting principles does not dispense with the necessity for insuring both the building and its contents against loss or damage by fire.

Theatres are generally insured—the contents less frequently. Such oversight is unaccountable, seeing that lessees and managers have a more substantial monetary interest in the scenery, wardrobes, properties, and general contents than in the building itself.

The insurance of rent is also a matter worthy of the consideration of those connected with theatres. All insurance offices do not entertain theatre risks, but amongst the companies doing this class of business there exists no competition. The rates of premium are fixed by mutual arrangement, and vary, according to circumstances, from 31s. 6d. per cent. to 60s. per cent. Some insurance offices have reduced the premiums so low as 20s. per cent. in cases where all the inflammable parts of the structure have been coated with an anti-ignition solution, such as the "Cyanite" fireproof paint. (See page 91.)

Before the insurance office accepts the risk, the building is carefully inspected by the surveyor to the company, whose examination is generally very carefully conducted, although it would be easy to point out several instances where the utmost laxity appears to have prevailed.

The following are a few of the more particular matters to which the insurance surveyor will devote special attention :—

1. Area and cubical capacity of the building.
2. Distance from adjacent buildings.
3. Surrounding risks—number and nature.
4. Position of the carpenter's shop, wardrobe-rooms, scene stores, and the general disposition of inflammable materials and properties.
5. Construction of the sun-burner, distance of timbers from the ventilating shaft, &c., and how protected.

6. System of ventilation and warming: position of hot-air furnace or boilers, general disposition of hot-air flues or water-pipes, and distance from inflammable substances.

7. How the scenery is guarded from contact with the stage lights.

8. Position of scene-painting room.

9. Gas-lighting arrangements: description of tubing, position of meters, arrangement of lights, and how protected.

10. Electric lighting installation: general disposition of wires and their insulation, position of engines, dynamos, &c.

11. Fire-extinguishing appliances: number and position of hydrants, pressure of water, length and condition of hose, number of firemen, trained or otherwise.

12. Number of employés, and whether they are drilled in the use of the fire appliances.

13. Length of time the theatre has been built; whether fires have occurred, and from what causes.

14. General construction of theatre; nature of materials, fire-resisting or otherwise.

# MODEL REGULATIONS.

THE following set of model regulations have been compiled from various sources, including those in operation in Continental, American, and Metropolitan theatres. The Author submits these regulations to municipal authorities, licensing magistrates, and all who may have the supervision of places of public entertainment, as being sufficiently comprehensive to give real assistance in the preparation of a modified set of regulations suitable for existing buildings :—

1. Every theatre, opera-house, concert-hall, lecture-room, or other building to be used for public entertainments or for the reception of any number of people exceeding 150, which may be hereafter erected, or any existing building which may be altered to be used for such purpose, shall be built in strict accordance with the following regulations, and no building hereafter erected shall be opened for the reception of the public until the same has been approved by the authorities, and a certificate has been issued testifying that such building conforms in its structure and general arrangements with all the essential requirements of the following regulations :—

2. Every person desirous of building a theatre, opera-house, concert-hall, lecture-room, or other building to be used for public entertainments shall submit, for the approval of the authorities, a complete set of general drawings of the proposed building, including plans of each floor, with longitudinal and transverse sections through the stage and auditorium, drawn to a uniform scale of eight feet to one inch, together with detail drawings showing the general construction of the roofs, floors, and stagings. Such drawings shall be accompanied by a specification, and these together shall combine the following information for the guidance of the authorities: the proposed construction of the buildings, the materials to be used, the systems of water-supply, the number and position of fire hydrants and other appliances, the method of lighting (whether by gas, electricity, or both combined), the system of drainage, the arrangement and number of seats proposed for each tier or level, together with a comprehensive description of the

systems of warming and ventilation, and any further details that may be requested by the authorities.

3. The number of persons to be accommodated in each section of every theatre, &c., and the superficial area to be allotted to each spectator, shall be determined by the authorities, and every theatre, &c., shall be licensed to hold such numbers as the authorities shall determine.

4. Every responsible manager who shall admit to a duly licensed building a larger number of persons to each section than is provided for in the terms of his licence shall be liable to a penalty of for each offence or to the withdrawal of his licence, at the discretion of the authorities.

5. No person shall use, or cause to be used, for the reception of the public, any theatre, &c., unless the same shall have been surveyed and certified as conforming with existing regulations. Certificates shall be renewed yearly by the authorities, on the production of satisfactory evidence that the theatre, &c., has been well conducted, that existing regulations have been duly observed, that the building is structually safe, and that no unauthorised alterations have been made.

6. All proposed alterations to existing buildings shall be carried out in conformity with the regulations applicable to new buildings.

7. The authorities, or their duly authorised representative, shall have power to enter every theatre, &c., at any time, for the purpose of inspection, and the authorities shall have power to require alterations to be made to any part or fitting of every theatre, &c., which shall be found, on inspection, not to conform with existing regulations ; and the authorities shall further have power to close any such theatre, &c., or portion of such theatre, &c., or withdraw the licence until the necessary alterations shall have been made and the regulations complied with.

8. The authorities shall, within one week of receiving drawings and applications, acknowledge the receipt of the same, and shall, within one month, notify to the applicant their approval or disapproval of any scheme or application submitted for their consideration.

9. The authorities shall employ a staff of competent inspectors, whose technical training shall have fitted them for the supervision of places of public entertainment. Such inspectors shall be

empowered to enter every theatre, &c., at any time, for the purpose of inspection, and shall report to the authorities every case of non-compliance with these regulations, either in existing buildings or in theatres, &c., undergoing alteration or construction.

10. In every town where a theatre, &c., shall be erected the authorities shall appoint a local committee, whose duty it shall be to periodically inspect the theatre, &c., with special regard to its stability and internal arrangements as to safety from fire and the security of the public. These local committees shall consist of several persons—(1) chief of the local fire brigade, (2) chief of the police, the doctor appointed to the theatre, one or more magistrates, one or more members of the town council, local board, or vestry, and an architect or practical builder.

11. The authorities shall have power to modify these regulations in their application to existing buildings, and to make special rules according to circumstances.

12. No alterations shall be made in a theatre, either in the structure, the disposition of the exits, or the internal arrangements, without the previous approval of the authorities.

13. Every theatre shall be provided with such means of warning and escape as may be approved by the authorities.

## GENERAL CONSTRUCTION.

1. In the arrangement and construction of every theatre, &c., the several departments of auditorium, stage, dressing-rooms, workshops, stores, managerial offices, &c., shall be separated by solid brick walls, the thickness of which shall be approved by the authorities. Such walls shall be carried up through the roofs, and built to a height of three feet above the outside surface of roof covering.

2. No more openings shall be permitted in divisional walls than are absolutely necessary for the practical working of the theatre, &c., and all such openings shall be fitted with self-closing fire-proof doors.

3. All roofs shall be flat and of fire-proof construction, and where there are several levels these shall be connected by iron ladders.

4. All floors shall be constructed with fire-proof materials, and shall be supported by corbels or off-sets from the walls.

5. All steps, landings, and floors of exit passages shall be constructed with artificial stone, concrete, terra-cotta, or other approved fire-resisting material.

6. All iron columns, girders, rolled joists, or other constructional ironwork shall be encased in plaster, cement, or asbestos.

7. All wood beams, timbers, rafters, joists, or other woodwork shall, without exception, be coated with an approved fire-resisting solution.

8. All the structural parts of every theatre, &c., shall be built of such strength as to sustain safely at least twice the weight and double the strains to which the parts can be possibly subjected.

9. No wood, canvas, or temporary construction shall be permitted, but all partitions shall be constructed with plaster finishings, and the interspaces filled in with some non-combustible material.

10. The aggregates used in the formation of fire-proof concrete shall be such as have been previously calcined.

11. Every theatre, &c., hereafter erected shall be entirely isolated from surrounding buildings, and no part of a theatre, &c., shall be nearer to contiguous structures than 20 feet.

12. In theatres, &c., where workshops are provided as part of the building, such workshops shall be separated from the main building by solid brick walls without openings for communication or by an open area not less than 10 feet wide.

13. In all theatres, &c., hereafter built the pit floor shall be constructed below the street level, and not more than three tiers of galleries shall be permitted within the auditorium, and in no case shall the highest point of the gallery floor be more than 50 feet in vertical height above the pavement level of the gallery exit.

14. All windows the sills of which are more than 8 feet above the street pavement level shall open into iron balconies, from which means shall be provided for descent into the street.

15. All decorations, finishing, and fixtures shall be of incombustible materials, and shall adhere exactly to the surfaces covered, without any intervening spaces.

16. Where fire-proof doors are permitted by the authorities, they shall be hung in iron frames securely built into the walls, and so arranged as to be self-closing.

17. All iron doors shall be of such pattern, material, and construction as shall be approved by the authorities.

18. All staircases, corridors, passages, offices, saloons, foyers,

retiring-rooms, dressing-rooms, stores, workshops, and every part of the building, shall be lighted by windows, so that artificial light may not be required during the day in any part of the theatre.

19. All underground rooms shall be lighted by windows having external areas lined with white tiles or glazed bricks, and covered with approved pavement lights.

20. One or more lightning conductors shall be fixed to the highest points of the building.

21. There shall be constructed outside the theatre building, or within an open area, an iron furnace with a proper chimney shaft or flue, and all rubbish, sweepings, shavings, and chips, shall be burnt each day.

## Entrances and Exits.

1. All entrances shall be protected from the weather by verandah covers of iron and glass or permanent awnings, extending the full width of the street pavement.

2. Where practicable, the *queue* system of admitting the public shall be adopted.

3. No external door shall be closed after the public have been admitted to the theatre, &c., but shall be fixed open by means of a catch, in such manner as not to impede the egress of the audience.

4. All doors in every theatre, &c., used by the public shall open outwards, or in the direction of exit only, and no swing or sliding doors or revolving shutters shall be permitted, and no doors giving access to saloons, cloak-rooms, or other offices shall open across passages or lobbies to obstruct the line of exit.

5. Where external exit doors are permitted to be closed, the fastenings used shall be such as to readily yield to pressure from within.

6. No door or passage in the line of exit from any section of a theatre, &c., shall be of less width than 4 feet 6 inches.

7. Each section of the audience in every theatre, &c., shall have two separate and direct means of egress from the building into the street, and these exits shall be arranged on each side of the auditorium.

8. All exit openings, passages, and corridors shall have a width of not less than one foot for each fifty persons.

9. All exit doors shall be conspicuously indicated by permanent inscriptions.

10. No pass door or other means of communication shall exist between the exit corridors or staircases provided for separate sections of the auditorium.

11. Separate exits shall be provided, communicating direct with the street from the stage, dressing-rooms, workshops, and managerial department.

12. A fireproof passage shall lead direct from the orchestra to the street or into an exit corridor.

13. No emergency doors shall be permitted in any theatre, &c., and all external doors shall be used as exits at each performance.

14. No fastenings shall be attached to internal doors used by the public in the line of exit.

15. All locks throughout a theatre, &c., shall be fitted *en suite*, and each attendant and fireman shall be provided with a pass-key.

16. Internal screen doors fitted in exit passages shall have the upper panels glazed, and be equal in width to the external exit doors provided for the section of the auditorium in which they are fitted.

17. All exit corridors shall be kept clear and unobstructed, and under no circumstances shall temporary pay-boxes or movable barriers be permitted in an exit passage or staircase.

18. A fireproof passage shall lead from the prompt direct to the street or into an exit corridor.

19. All internal doors of dressing-rooms, lobbies, foyers, crush-rooms, and offices, &c., shall be provided with a wicket, placed in such position as to facilitate inspection by the fireman during the regulation patrol.

20. During each performance the doors of communication between the auditorium and the stage shall be closed.

21. The exits shall be in such numbers and so disposed that in an emergency it may reasonably be anticipated the theatre will be emptied in TWO MINUTES.

## STAIRCASES.

1. Each section of the auditorium of every theatre, &c., shall have two separate staircases communicating direct with the street, and shall be at *least one-fourth* wider than the regulations require for passages and corridors.

2. The supporting and enclosing walls of all staircases, together with the landings and steps, shall be constructed with fire-proof materials.

3. The width of the treads shall not be less than 11 inches, nor the risers exceed 7 inches in height.

4. Not more than ten steps shall be allowed in any one flight, and three steps shall be the least number allowed.

5. All landings shall be square on plan, and no "winders" shall be allowed.

6. In no case shall doors be fitted on staircase landings, either temporarily or permanently.

7. All staircases, without exception, shall be lighted by windows and well ventilated.

8. The roof or ceiling of all staircases shall be formed with fire-proof materials, and without any skylight or other opening.

9. All staircases, exit passages, and corridors shall be provided with stout, continuous hand-rails, recessed flush with the walls, and where such hand-rails project from the walls the regulation width prescribed for staircases shall be measured between the hand-rails.

10. Staircases exceeding 7 feet in width shall be provided with a strong central hand-rail.

11. Where staircases are constructed in long, straight flights, without turnings, not more than twelve steps shall be permitted without an intervening landing, and such landing shall not be less than a full stride across.

12. Staircases for communication between different sections of the auditorium for the public use shall not be permitted.

13. The staircases shall be so apportioned and of such width that the time allowed for emptying the theatre on ordinary occasions shall not exceed *four minutes.*

14. A "pass" staircase shall be provided, of not less width than 3 feet 6 inches, communicating with each level of the auditorium, the managerial offices, stage, and watch-room. This staircase shall be for the exclusive use of the manager, firemen, and working staff of the theatre, and shall communicate with the street. All openings shall be fitted with self-closing iron doors, and shall not be used by the public or for the purpose of "transfer."

15. Where it is practicable to substitute slopes in lieu of steps, this shall be done, but the rake shall in no case exceed 1 in 12.

## Pay-Places.

1. Separate pay-places shall be provided for each section of the audience.

2. All pay-places shall be arranged as an integral part of the building, and shall in no manner project into the exit passages or lobbies, or in any respect impede the egress of the audience.

3. Temporary pay-boxes or barriers shall not be permitted in any part of the building.

## Corridors and Gangways.

1. Fireproof corridors shall be provided at the back of the pit and each tier level, and these shall be in direct communication with the exit passages and staircases.

2. These fireproof corridors shall be sufficiently spacious to accommodate the entire audience in each section of the auditorium, and shall be lighted by windows and well ventilated.

3. Means of access shall be provided from the fireproof corridors to the outside balconies or arcades.

4. The area of the fireproof corridors shall not be less than 250 superficial feet of floor room for every 100 persons, and in no case shall the width of the corridors be less than 5 feet.

5. All corridors and passages shall be clear and unobstructed, and no pilasters or other projections shall be permitted at a less distance than 5 feet from the floor level.

6. No cloak-pegs, umbrella-stands, loose chairs, or check-boxes shall be allowed in corridors used by the public.

7. No two exit corridors shall meet at right angles, but at their junction shall take a common direction, and the continuing corridor shall be equal in width to the two exit corridors combined.

8. At the sides and back of each section of the auditorium seating, gangways shall be formed not less than 3 feet 6 inches wide.

9. All lines of seating throughout shall be intersected by gangways leading to the fireproof corridors, and so arranged that there shall not be more than twelve seats in each row between every two gangways.

10. The width of the gangways shall at least be equal to that of two seats in the front rows, and increase in width to three seats

at the back rows ; and, where practicable, the gangways should be in line with the exit doors or staircases.

## Seating.

1. All seats throughout the auditorium shall be fixed to the floor.

2. All seats with backs shall be constructed so as to fold against the back.

3. The area to be assigned to each person shall not be less than 24 inches by 18 inches in the pit and gallery, nor less than 30 inches by 20 inches in other parts of the theatre.

4. All gangways and approaches to the seats shall be kept clear, and shall not be used as standing-room.

5. The gangways in the upper tiers shall be divided by stout hand-rails, and these shall be secured to the guard-rails fixed to the circle fronts.

6. The licensed number of seats, whether in the boxes, stalls, dress circle, numbered or unnumbered seats, and the space for standing, shall not be increased on any pretence whatever.

## Standing.

1. Standing-room shall only be allowed at the back of the pit and gallery, and only in spaces specially set apart for the purpose.

2. The area assigned to each person in the standing-spaces shall not be less than 3 feet superficial.

3. A gangway not less than 3 feet 6 inches wide shall intervene between the last row of seats in the pit or gallery and the standing-spaces, and under no circumstances shall this gangway be used for standing-room or other purposes.

## Royal Box.

1. In connection with the Royal or State box shall be provided the following :—

(*a.*) A separate entrance from the street, having a covered approach.

(*b.*) Private fire-proof staircase.

(*c.*) Retiring-room, furnished as a lounge or sitting-room.

(*d.*) Small ante-room, for attendants, cloaks, &c.

(*e.*) Lavatory and sanitary conveniences.

2 The Royal entrance shall not be used by the public at any time.

### Cloak-Rooms and Sanitary Provisions.

1. All cloak-rooms, foyers, refreshment-saloons, and smoking-rooms shall be constructed only on the outer side of the containing walls of the auditorium.

2. Cloak-rooms shall be so arranged that the persons using them shall in no way interfere with the free and easy egress of the public.

3. Cloak-rooms shall not be placed in exit corridors, and no temporary cloak-rooms or hat-pegs shall be permitted.

4. For each section of the auditorium separate sanitary accommodation shall be provided for men and women.

5. The retiring-rooms for women and the urinals for men shall be placed as far apart as practicable, and shall be arranged with due regard to propriety, and shall be well lighted by windows, properly ventilated, and sanitarily efficient.

6. The medical officer attached to the theatre shall report to the authorities once each month as to the efficiency of the sanitary appliances and the general hygienic condition of the building.

### Smoking and Refreshment Saloons.

1. Saloons, foyers, and waiting-rooms shall be arranged in such positions as not to intervene between the line of exit from the auditorium to the street.

2. Smoking-rooms shall be arranged as adjuncts to the refreshment-rooms, and shall be well lighted by windows and ventilated.

3. Smoking in any other part of the theatre shall be strictly prohibited.

### Managerial and Business Offices.

1. The business offices shall constitute a distinct section of the building, and shall be separated from the auditorium and stage by solid brick or masonry walls.

2. All openings between the business offices and the theatre proper shall be fitted with self-closing iron doors.

3. The necessary offices shall be provided for the business manager, the acting manager, treasurer, and their staff of assistants.

4. Sanitary conveniences shall be provided for the business offices.

5. A distinct and separate exit into the street shall be arranged in connection with the business offices.

## Orchestra.

1. The orchestra shall be divided from the mezzanine of the stage by a solid brick wall, 14 inches thick.

2. The means of access to the orchestra shall be as provided for in Reg. 12, Entrances and Exits.

3. The space set apart for the orchestra shall not be used by the spectators.

## Proscenium Wall and Fire-proof Curtain.

1. The stage shall be separated from the auditorium by a solid brick or concrete wall, in no part of less thickness than 14 inches. This wall shall be carried down to the level of the footings of the containing walls of the stage, and carried up through the roof to a height of 5 feet above the outer covering of the stage roof.

2. The proscenium opening shall be spanned by a brick-in-cement arch of not less than four rings, and the tympanum of such arch—if the proscenium frame is finished square—shall be filled in with brickwork not less than 9 inches thick, and supported on stout flitched beams, encased in fire-proof plaster or cement.

3. No openings shall be allowed in the proscenium wall, with the exception of that which is covered by the curtain, and a small opening admitting to the fire-proof passage from the prompt. (Reg. 18, Entrances and Exits.)

4. The decorations and enrichments forming the proscenium frame shall be of incombustible materials.

5. The proscenium opening shall be fitted with an approved fire and smoke proof curtain, which shall be of such construction as to withstand the pressure of gaseous vapours and the shocks of falling scenery. The curtain shall further be of such construction and materials that it will not be destroyed by heat or flames for some definite period after the outbreak of a fire.

6. The proscenium curtain shall be raised and lowered by hydraulic or other approved machinery, so arranged that the curtain may be set in motion from the prompt, the WATCH-ROOM, and some convenient position in the auditorium.

7. Thirty seconds shall be the maximum time allowed to lower

the fire-proof curtain, which shall always be lowered with the act-drop or baize.

8. In the event of fire the fireman on duty on the stage shall be held responsible for the instant lowering of the fire-proof curtain.

9. Should the authorities deem it desirable that openings should be made in the proscenium wall for the use of the firemen, such openings shall be fitted with iron doors (Reg. 16 and 17, General Construction), which shall be locked, and on no pretext used for the ordinary business of the theatre. One key of such doors shall be in charge of the chief fireman, and another hung up in the WATCH-ROOM. A third key shall be locked in a box at the prompt, having a glazed front, with explanatory inscription.

10. The metal curtain shall be kept down at all times, except during the acts and general rehearsals.

## THE STAGE.

1. All the containing walls of the stage shall be constructed with solid brickwork or masonry, and of such thickness as may be required by the authorities.

2. The stage above and below shall be divided from the workshops, property-rooms, and dressing-rooms by brick walls not less than 18 inches in thickness.

3. All internal openings, giving access to the stage, shall be fitted with self-closing iron doors. (Reg. 16 and 17, General Construction.)

4. All the framing of the stage, flies, gridiron, and roof shall be constructed with iron, and all woodwork shall be periodically coated with an approved anti-ignition solution.

5. The height from the stage floor to the gridiron shall be sufficient to allow the cloths to be raised without rolling or folding.

6. The width of the stage shall be not less than twice the width of the proscenium opening.

7. Level with the stage floor shall be provided a scene dock, having a floor space equal to at least one-eighth of the superficial area of the stage.

8. Where a brick wall only separates the carpenters' shop and other workshops from the stage, no openings shall be allowed.

Where an open area intervenes (Reg. 12, General Construction) an opening may be formed, not exceeding 3 feet in width, nor of greater height than half the width of the proscenium opening, and shall be fitted with self-closing iron doors (Reg. 16 and 17 General Construction).

9. All doors communicating with workshops, property and store rooms shall be closed during a performance or rehearsal.

10. The front of the fly galleries shall be protected by a stout rail and open framing, and also the service bridges between the flies.

11. All machinery and fittings on the stage, below the stage, and also above, shall, as far as practicable, be of fireproof materials.

12. All combustible parts of machinery, scenery, and fittings, including cloths, wings, slips, set scenes, borders, mediums, and gauzes, shall be impregnated with an approved fire-resisting or anti-ignition solution.

13. All the materials prepared for any new piece, and all articles required to be impregnated with anti-ignition solutions, shall be subjected to examination and proof by the authorities or their inspector before the first public performance.

14. In all other cases where the regulations require the application of fire-resisting solutions the materials shall be examined and proved at least twice a year.

15. Not more scenery than is required for two plays shall be permitted to remain on the stage and in the scene docks

16. Scenery shall not be stored in the mezzanine or cellar, but only in scene docks specially constructed for the purpose.

17. Only hemp cords shall be used for suspending scenery.

18. All counter-weights shall be encased.

19. Carpentering, scene-painting, or property-making shall no be performed on the stage, but in rooms specially set apart for these purposes.

20. Combustible or explosive properties and fireworks shall not be stored on the stage, but shall be kept in a room specially provided.

21. Gunpowder, fireworks, explosives, coloured fires, or detonating properties required for immediate use shall be under the care of the fireman.

22. When fire-arms are used the scenes shall be so arranged that the shots are not directed towards the auditorium.

23. The stage in every part shall be kept free from dirt, rags, shavings, sawdust, straw, rubbish, &c.

24. No temporary or other dressing-rooms shall be permitted within the containing walls of the stage.

25. Exits shall be provided on each side of the stage, giving access from the mezzanine, stage floor, flies, and gridiron to fire-proof passages or staircases communicating direct with the street.

26. A powerful exhaust ventilator shall be fitted over the stage roof, of a capacity sufficient to discharge a volume of air equal to the cubical area of the stage three times each hour.

27. Scene doors and exit doors formed in the side walls of stage shall open outwards towards the street.

28. The soffit of the fly-galleries shall, when these are constructed with wood, be either plastered or covered with sheet-iron or tin.

29. The means of escape and the exits from the stage shall be of the most satisfactory nature, so that the firemen, scene-shifters, and other workmen employed on the stage may, in moments of danger, have a sense of personal security.

## Workshops.

1. No workshops, property rooms, nor stores shall be arranged within the containing walls of the stage or auditorium.

2. All workshops, &c., shall be arranged as a separate section of the theatre building, and shall be separated from the stage and auditorium, vertically and horizontally, by walls and floors of fire-proof construction.

3. Separate workshops, with the requisite fittings, shall be provided for the following trades: carpentering, modelling, property-making, smith, gasfitting and plumbing, wardrobe-making, and scene-painting.

4. Separate rooms shall also be provided for the stowage of properties and scenery not required for current use.

5. Where the painting-room is immediately over the stage scene-dock the cuts in the painting-room floor for lowering the scenery shall be closed with iron flaps.

6. No wax or oil shall be used by the scene-painter.

7. Sanitary conveniences shall be provided for the use of scene-shifters and in connection with the workshops.

## Dressing-Rooms.

1. The dressing-rooms shall constitute a distinct section of the building, separated from the stage and auditorium by solid brick or masonry walls.

2. The dressing-room block shall be divided into two sections, one for men, and the other for women, having separate approaches and staircase from the stage.

3. The staircases and corridors giving access to the dressing-rooms shall be constructed with fireproof materials, and shall not be less than 3 feet 6 inches wide.

4. Direct access from the dressing-rooms to the street shall be provided, and in no case shall it be permissible to enter the dressing-room section across the stage only.

5. Separate sanitary conveniences for men and women shall be provided in each section of the dressing-room block.

6. No room shall be used for the purposes of a dressing-room unless means are provided for lighting, ventilating, and warming.

7. Each dressing-room shall be provided with window space equal to not less than one-tenth of the floor area.

8. Water shall be laid on to all dressing-rooms.

9. Arrangements shall be made for signalling to the dressing-rooms in moments of danger, and the means of escape shall be satisfactory, so that the actors and actresses may leave the building as promptly as possible, lest by their impetuosity and excitability they throw into confusion the *life-saving organisation.*

## Lighting.

1. Only electricity, gas, and oil lamps shall be allowed to be used in lighting theatres.

2. The use of the electric light shall be compulsory in all theatres where the authorities are satisfied that its introduction may be carried out at a reasonable expenditure.

3. The lighting arrangements shall be in the charge of a practical gas or electrical engineer, who shall be provided with an efficient staff to assist him.

4. The duties of the lighting engineer shall be to supervise the various systems of gas and electric lighting, the trimming and placing of the oil lamps, and generally to maintain the whole in a state of efficiency.

5. The lighting engineer shall not be employed on duties outside his particular calling.

6. Every theatre lighted by gas shall have a dual system throughout, with separate meters, having distinct service and supply pipes.

7. Each system of gas-lighting shall be divided into three sections, supplying respectively the stage, auditorium, lobbies and exits.

8. In the auditorium section the dual systems of gas service shall supply alternate lights.

9. Each system shall have a separate meter, and these shall be placed in a fire-proof chamber, well ventilated, and as near the prompt as practicable.

10. The following supplies shall be controlled from the gas-plate fitted at the prompt: stage-lights generally, foot-lights, dressing-rooms, and the sunlight or chandelier in the auditorium.

11. The gas supplies to the auditorium (with the exception of the sun-burner), foyers, retiring-rooms, lobbies, corridors, staircases, and entrances shall be controlled from the WATCH-ROOM.

12. Provision shall be made in every case for turning on the gas supply direct from the main in the event of failure in any one of the meters.

13. Stop-cocks for turning off the gas supply from the main shall be fitted in the WATCH-ROOM and sealed, and the supply shall only be turned off by the chief fireman or by his personal instructions.

14. The auditorium shall be lighted by a central sun-burner, having an iron flue to carry off the products of combustion. This flue shall be constructed within an outer ventilating shaft not less than 7 feet by 7 feet, and fitted above the external roof with louvre framing or an approved extraction cowl.

15. Where sun-burners are not used, openings shall be formed in the auditorium ceiling to carry off the smoke in the event of fire.

16. Where a chandelier is used this must be supported on strong iron brackets, and raised or lowered by means of a winch, and the movement of the chandelier shall be regulated by counter-weights, and it shall be further suspended by two metal ropes each having a breaking weight equal to the total weight of the machinery.

17. A wire gauze shall be provided to protect the spectators in the case of glasses or prisms becoming detached.

18. Gas-brackets fixed round the fronts of the tiers shall not be allowed.

19. All gas-burners within the auditorium and its adjuncts shall be lighted 30 minutes, and electric lights 15 minutes, before the admission of the public.

20. No lights shall be extinguished within the auditorium or its adjuncts for at least 15 minutes after the close of the performance.

21. All burners shall be lighted by the electric spark or safety lamp, and no naked flames nor matches shall be used for "lighting up."

22. All gas-pipes shall be of hard metal, and shall be so fixed as to admit of easy inspection.

23. All gasfittings shall be of the best description and approved by the authorities.

24. No jointed, swinging, nor telescopic fittings shall be allowed.

25. All gaslights within the auditorium and its adjuncts, the dressing-rooms, and general offices shall be provided with a metal cone receiver or other approved means for carrying the products of combustion to the outer air.

26. No gaslights shall be allowed nearer to any combustible material than 3 feet 6 inches vertically, and 2 feet horizontally.

27. All gas-jets shall be protected by wire globes, and glass globes shall only be permitted in the external vestibules and the approaches to the stalls and dress circle.

28. All gas-jets shall be turned on and off by a special key, without taps.

29. All gas-lights on staircases and exit passages shall be encased in recesses formed in the thickness of the walls.

30. No hanging lights shall be placed nearer the stage floor than 4 feet, and shall be protected by a network of close mesh, and the upper part surmounted by a smoke-consumer of suitable size.

31. All batten lights shall be suspended by not less than three metal ropes, and encased by wire netting to prevent contact with mediums, borders, or moving scenery.

32. Where practicable, the mediums should be of glass or other incombustible transparent material.

33. All flexible tubes shall be covered with leather and fitted with instantaneous couplings. Common gutta-percha tubing shall not be allowed.

34. The most approved form of water-joint shall be used for connecting all temporary or movable lights. (See page 77).

35. All gas supplies to movable lights shall be turned off in the permanent supply pipe, and not in the flexible tubes.

36. The footlights shall have the burners reversed and ventilated to the outer air by special flues, and the lights shall be protected by wire guards. (See page 74).

37. All rows of light on the stage shall be fitted with an approved " flash " arrangement.

38. All ground-lines shall be protected with wire trellis of close mesh.

39. The taps regulating the gas supply governed from the stage shall be fitted to an index-plate at the prompt, and each tap shall be distinctly labelled, indicating the section of lighting it regulates.

40. The use of mineral oils, spirits, hydro-carbon, and portable gas shall not be allowed.

41. Safety lamps for the inspection of gas escapes shall be kept in the WATCH-ROOM ready for use.

42. Every three months a thorough examination shall be made of all meters, gas-pipes and fittings, &c., and readings taken from the several meters, after the main supply has been turned full on and all taps throughout the building shut off, for a period of three hours, to check the escape of gas.

43. Tanks shall be provided outside the building or within an open area for the storage of gases required for the oxy-hydrogen light, and shall be fitted with an approved water-pressure arrangement.

44. Metal pipes only shall be used for conveying the gases to the stage.

45. Bags for the storage of gas within the theatre shall not be allowed.

## Oil Lamps.

1. In every theatre, whether lighted by gas or electricity, a supplementary system of lighting by oil lamps shall be adopted throughout the entire buildings.

2. A room shall be provided in which the lamps shall be stored and trimmed during the day.

3. Only colza oil shall be used for trimming the lamps.

4. A lamp shall be attached to every third gas or electric light bracket throughout the building before the public are admitted and shall be kept burning until the audience has left the theatre.

5. Red lamps, having the word "Exit" written upon them in white letters, shall be placed over each exit door.

6. The lamps used by the firemen and attendants, unless they are electric lamps, shall be of the local fire brigade pattern.

7. All oil lamps shall be fed with fresh air from the outside, and receivers provided to carry off the products of combustion, for which purpose they may be placed within recesses formed in the walls.

8. Carrying naked lights or burning coals about any part of the theatre shall be strictly prohibited.

## Electric Lighting.

1. Where the electric light is adopted the installation shall be carried out in strict accordance with the rules prepared by the Society of Telegraphic Engineers and Electricians. (*Vide* page 83.)

2. Where gas is not provided a dual system of machines and wires shall be installed, as provided for in gas-lighting. (Reg. 6.)

3. The services for the stage and auditorium shall be distinct, having separate circuits of wires and dynamos.

4. The engines and dynamo machines shall be placed in a fireproof room specially constructed and outside the main building.

5. There shall be a reserve engine and dynamo for each system or service.

6. Where accumulators are used, reserve batteries shall be provided with means for switching on the current at a moment's notice.

7. A "cut-off" switch shall be fitted in the WATCH-ROOM, whether the electricity is generated within the building or from an outside source.

8. All wires shall be of sufficient thickness to prevent over-

heating, and shall be thoroughly tested under the supervision of the authorities before the light is permanently used.

9. All electric lights shall be protected in such manner as to prevent the falling of incandescent carbons or broken globes.

10. All wires for conducting electricity, gas-pipes, and, in general, the whole of the lighting apparatus, shall be constructed in such a manner as not to be easily put out of order, and shall be easy of inspection and under proper control.

11. All electric conductors shall be properly insulated, and shall run in grooves cut in the walls, or in pipes or other coverings beyond the reach of the public.

## Warming and Ventilation.

1. No open fireplaces shall be permitted in any part of the theatre, with the exception of the manager's offices.

2. Gas stoves recessed in bricks, jambs with proper flue, and protected towards the room by wire guards, shall be permitted in the public rooms and dressing-rooms.

3. All flues to stoves, burners, &c., shall be cleaned every three months.

4. In theatres artificially heated, warmed air shall be adopted in preference to hot-water systems, which latter shall only be used at low pressure.

5. The furnace and apparatus shall be fitted in a vaulted and ventilated chamber or in an open area.

6. The hot-air conduits shall be constructed with earthenware.

7. The openings for admitting the warmed air to the auditorium and other parts of the theatre shall be covered with wire netting or ornamental gratings, and shall be at a distance of not less than 6 inches from the woodwork.

8. Where hot-water pipes are used, these shall not be placed nearer than 3 feet to any combustible material.

9. The warming apparatus of whatever kind shall be so constructed as to admit of easy inspection, and all hot-air ducts shall be periodically cleansed.

10. The whole of every theatre building, including the auditorium, passages, corridors, retiring-rooms, stage, dressing-rooms, workshops, &c., shall be ventilated upon a system to be approved by the authorities.

11. Whatever system of ventilation is adopted, not less than

4 cubic feet of fresh air per minute shall be injected into the auditorium for each individual.

12. The air within the auditorium and its approaches shall be changed absolutely not less than twice within each hour.

13. In addition to the exhaust over the stage roof (Reg. 26, The Stage), one or more ventilators or butterfly traps shall be fitted to the roof. These shall be equal to one-fortieth part of the area of the stage, and the flaps shall be worked by a wire rope from the stage floor near the prompt, and shall be opened in the event of fire, to carry off the products of combustion.

## Fire Extinction.

1. A staff of trained firemen shall be employed, and the chief fireman shall be responsible for the efficiency of the fire appliances.

2. During each performance not less than two firemen shall be in attendance on the stage, and one or more patrolling the building.

3. A WATCH OR FIREMAN'S ROOM shall be provided, in direct communication with every section of the building by means of a private staircase.

4. One fireman shall always be on duty in the WATCH-ROOM night and day.

5. The WATCH-ROOM shall be situated near the principal entrance, and shall be in electric or telephonic communication with the nearest fire-brigade station and the police-station.

6. Electric or telephonic means of communicating with the WATCH-ROOM shall be arranged from several parts of the building.

7. All fire appliances shall be of the local fire brigade pattern.

8. The fire appliances shall at all times be accessible for inspection by the authorities.

9. A staff of trained firemen shall be employed, and the numbers to be on duty within the theatre during and after the performance shall be regulated by the authorities. The firemen and the entire working staff of the theatre shall be regularly instructed in fire drill, by an officer of the local or town fire brigade, not less frequently than once each month, and the appointment of such officer shall be approved by the authorities.

10. Should the responsible manager fail to comply with the foregoing regulation, the authorities shall have power to detach the necessary number of men from the members of the local

fire brigade for theatre duty, and the expenses thus incurred shall be defrayed by the responsible manager of the theatre.

11. Before and after each performance a thorough examination shall be made of each section of the building, records of which shall be transmitted to the WATCH-ROOM by means of a self-registering apparatus to be approved by the authorities (see p. 97). These records shall be preserved for the inspection of the authorities, who shall thus satisfy themselves that the inspections are duly performed in accordance with this regulation.

12. All electrical or telephonic means of communication shall be tested daily at noon, and all fire appliances examined at the same time. The chief of the local fire brigade—or his representative—shall have free access to the theatre, to supervise the carrying out of this regulation and for the purposes of general inspection, at all times.

13. A "patrol service" shall be instituted during the performance, and the regularity of this duty shall be registered in the WATCH-ROOM by means of electric presses or buttons fixed at certain station-points in the building.

14. One special officer shall be placed in charge of the firemen and the fire appliances and signalling apparatus, and he shall on the outbreak of fire take immediate command of the entire working staff of the theatre.

15. A fireman shall be stationed at each hydrant twenty minutes before the doors are opened to the public, and the hose shall be attached, and in every respect ready for immediate use. In case of fire the water shall at once be directed upon the point threatened.

16. Firemen within the theatre shall have free access to every part of the building, and shall not be employed on other duties than those prescribed by these regulations.

17. The duties of the firemen are, briefly—

*(a.)* To carefully watch the building.

*(b.)* To conscientiously patrol every part of the theatre.

*(c.)* To see that the fire-curtain is in good working order.

*(d.)* To examine the electric cables, and see that these are properly insulated.

*(e.)* To work the hose, buckets, blankets, &c., in moments of danger.

*(f.)* To keep a sharp look-out for gas escapes.

*(g.)* To maintain the fire appliances in a thoroughly efficient working condition, and to report any defect in these to the responsible manager of the theatre.

*(h.)* To be trustworthy, sober, and courageous, without which qualifications he will be unfit for duty within a public building.

18. The fireman on duty on the stage shall be responsible for the lowering of the iron curtain at the end of each act, at the close of the performance, and in moments of danger.

19. The chief fireman shall report to the authorities and to the responsible manager any deficiencies he may notice in the fire appliances and arrangements entrusted to his charge.

20. Every fireman or member of the working staff convicted of negligence, absence from duty, intoxication, or insubordination shall be at once dismissed, and replaced by the responsible manager.

21. Every fireman and member of the working staff shall be provided with a signalling whistle or other approved means of communication, and a code of signalling introduced. This may be regulated by the number of blows, the use of clear or trembling whistles, or having distinct notes for each section of the building.

22. There shall be two distinct sources of water supply—one from the town mains, and the other from tanks elevated above the roof—so that the force of water shall be sufficient to discharge a stream of water from the nozzles to any combustible part of the structure.

23. The main pipes shall be of a size proportionate to the number of hydrants, and the diameter of the rising mains; number and position of the hydrants shall be approved by the authorities, who shall in these particulars be advised by the chief of the local fire brigade or other practical fireman.

24. The supplementary water supply contained in tanks shall equal one thousand gallons for each hydrant, and the fire-mains from these tanks shall be fitted with hydrants, hose, and nozzles, &c., in positions to be approved, and midway between the town main-supply hydrants.

25. Hydrants shall be fitted on every floor in each section of the building, at distances not exceeding 100 feet apart horizontally.

26. One or more hydrants complete shall be fitted outside the

building, in positions to be approved, and encased in wood or iron frames.

27. One or more hydrants complete, as above, shall be fitted on the external roofs, which latter, without exception, are all to be constructed as flats.

28. In addition to the hydrants, fire-buckets—kept constantly full of water—shall be placed on hooks in every section of the building, in such numbers and positions as the authorities may decide. In connection with each set of buckets, a draw-off tap shall be provided for filling.

29. One hand-pump and extincteur shall be provided for each section of the building.

30. The soffit of the gridiron shall be fitted with a series of perforated pipes, rose jets, or sprinklers, operated by taps fixed near the prompt, or any approved arrangement whereby a shower of water may be made to descend upon the stage.

31. Automatic fire appliances may be used, but shall not be regarded as substitutes for a system of hydrants.

32. A separate water-supply shall be provided for sanitary purposes, and consumption, and general uses.

33. Wet sponges, blankets, hatchet, and hooks for cutting down scenery, &c., shall be kept in readiness on the stage and in the flies.

34. If the pressure of water is insufficient to enable the water to be thrown from the upper hydrants to the top of the roof, approved "water-pressure augmenters" shall be attached to the hose and fixed securely to the floor. (See page 96.)

35. A code of instructions shall be drawn up and approved by the authorities, framed and hung in the WATCH-ROOM, at the prompt, in the dressing-rooms, and at each patrol-station in the auditorium and other parts of the building. This code shall clearly define the duties of the working staff and firemen as regards the general regulations of the theatre, and how to act in the event of fire or panic.

36. Iron ladders shall be fixed against the external walls for the use of firemen, and in such numbers and positions as the authorities may decide.

## GENERAL MANAGEMENT.

1. The auditorium shall be open to the public, and the performance shall commence at the time specified on the play-bill.

2. The pay-boxes shall be opened at least 30 minutes before the curtain rises, and no spectator shall be admitted except by the doors opened to the general public.

3. The admission of spectators into the auditorium before the opening of the ticket-offices shall be prohibited.

4. Pay-boxes and check-takers' offices shall be placed so as not to impede the ingress or egress of the public.

5. No movable objects shall be placed in vestibules or corridors that would, in the event of an emergency, interfere with the free movement of the public.

6. When morning and evening performances are given on the same day, an interval of at least two hours shall be allowed between the two performances, in order that the air, both on the stage and in the auditorium, may be absolutely changed.

7. Every theatre shall be provided with a special set of rules, drawn up in accordance with these regulations. These rules shall be submitted to and be approved by the authorities, and distributed among the actors and all persons employed upon the premises, and shall be hung up in several conspicuous positions throughout the theatre. These rules shall provide for the daily examination of the entire building, fire appliances, signalling apparatus, telephonic and electrical means of communication, the iron proscenium curtain, the precautions to be adopted when "lighting-up" and during the ingress and egress of the public, also the duties of each attendant in the event of fire, panic, or sudden alarms.

8. In the manager's office shall be kept, for the inspection of the authorities, an accurate set of plans of the theatre, showing the disposition of the seats and gangways, the direction of gas and water pipes, and wires laid down for lighting. (See page 47.)

9. Plans of each tier or gallery shall be hung conspicuously in that tier, together with a copy of the special rules and regulations of the theatre, so that the public may be afforded every opportunity of understanding the various positions of staircases, doors, &c., and the observances demanded of them in the event of an emergency.

10. Pamphlets containing plans of the theatre, to a reduced scale, and copies of the rules and regulations of the theatre, shall lie for sale at the ticket-offices.

11. The management shall be responsible for giving the alarm of fire to the public at the right moment.*

12. The official inspectors appointed by the authorities shall have free access to all parts of the building.

13. A medical man, approved by the authorities, shall be attached to every theatre, whose presence shall be compulsory at each performance.

14. A small room near the auditorium shall be set apart for the use of the doctor and inspector; and a box shall be provided, fitted with medical appliances, for use in case of accidents or sudden illness.

15. Seats in the auditorium shall be reserved at each performance for the use of the doctor and the official inspector.

16. The scale of charges for seats shall be indicated on the play-bills and on the programmes. The charges shall also be affixed to the box-office, in a conspicuous position; and the charges having once been announced for a performance, shall not be altered.

17. Only numbered seats shall be booked in advance, and the the booking shall be discontinued at least one hour before the performance commences.

18. No seats shall be ticketed "Reserved" unless they shall have been legitimately "booked" and paid for.

19. No lights in the interior of the auditorium or of its dependencies shall be extinguished until the public have entirely left the building, and the auditorium shall be lighted thirty minutes before the admission of the public.

20. Every part of the theatre shall be carefully swept, washed, and cleaned each day, and all rubbish thus accumulated shall be disposed of as provided for in Reg. 21, General Construction.

21. Cleanliness generally in all parts of the building shall be a special duty.

22. No part of a theatre building shall be used as a dwelling-place, and sleeping upon the premises shall be strictly prohibited.

* In the event of a fire upon the stage it will be the duty of the fireman to lower the fire-proof curtain instantly. On ordinary occasions it is not desirable to expose the iron curtain to the audience until the end of the performance, when lowering the iron curtain will be the signal for the audience to depart; and the public should be instructed that the lowering of the iron curtain without the act-drop is to be regarded as a signal to leave the building. On the curtain might be written, in large letters, this notice: "The public are requested to leave the building. To prevent accident to yourselves and others, do not push, BUT FOLLOW; the theatre will thus be emptied in two minutes."

23. No persons other than those employed in the theatre shall be permitted on the stage during a performance.

24. No part of a theatre building shall be sublet for any purpose whatever, and all rooms, workshops, stores, &c., not used for the business of the theatre shall be locked up, and the keys deposited in the WATCH-ROOM and ticketed.

25. Whenever the representation of a piece shall include a conflagration or an explosion, or the discharge of fireworks or fire-arms in large numbers, the services of extra firemen shall be obtained for duty on the stage, and, when practicable, such extra firemen shall be drafted from the local fire brigade.

26. All attendants and firemen employed within the theatre shall wear a distinctive uniform, and shall be periodically instructed in the use of the fire-extinguishing appliances and the duties devolving upon them in the event of fire, panic, or sudden danger.

27. Each door throughout the theatre shall have written upon it, in clear, legible characters, the name of the room or corridor to which it leads.

28. The position and direction of each exit shall be indicated by permanent notices affixed to or written upon the walls, at a height of 6 feet 6 inches from the floor.

29. Upon each exit-door shall be written, in red or white letters, the word "Exit," and also the name of the street into which it leads.

30. The number of persons admitted to each section of the auditorium shall not exceed the licensed number.

31. At some conspicuous point within each separate section of the auditorium shall be indicated, for the guidance of the public, the number each section is licensed to hold.

32. The licensed numbers shall also be printed upon all programmes and play-bills.

33. The responsible manager shall remain within the theatre during the whole time of a performance.

34. The whole of the theatre shall be inspected previous to every performance, and a permanent fire-watch and system of patrolling during the day and night shall be instituted, to the satisfaction of the authorities, and the work of inspection shall be registered in a log-book kept in the WATCH-ROOM for the purpose of examination by the authorities or their inspector.

35. The manager of each theatre shall be held responsible to the authorities for the due and exact observance of these regulations, and the authorities shall have power to withhold or cancel their licence on satisfactory evidence of non-compliance with these regulations on the part of any manager or proprietor.

# MANAGERIAL RULES.

THE following managerial instructions, for the guidance of the public and employés, are based upon the foregoing observations. It is desirable that they should be posted prominently before and behind the curtain, as they may severally apply :—

1. Should circumstances arise to necessitate the speedy dismissal of the audience, the manager desires to impress upon the public that every precaution has been adopted to secure their safety.
2. The arrangements made by the manager are such that any accident or evidence of danger, however trivial, is immediately notified to him.
3. It is earnestly requested that the audience will give no heed to any cry or alarm that may be raised by irresponsible individuals.
4. On the slightest danger arising, the public will be officially requested to leave the building.
5. Should such occasion unfortunately arise, the manager trusts that he may rely upon the audience to follow the instructions of the attendants, who have been carefully advised how to act.
6. Each exit-door is in charge of an attendant in *uniform.*
7. All doors marked with "Exit" lead direct into the street.
8. The average time taken to empty the theatre, allowing for obtaining hats, cloaks, and bonnets, is minutes.
9. It is confidently anticipated that not more than minutes would be required to clear the theatre, the audience passing out as on ordinary occasions, but without waiting for hats or cloaks, &c.
10. Every part of the building is in electrical or telephonic communication with the WATCH-ROOM. Not more than seconds could elapse after an accident before it would be officially communicated to the audience by an attendant from the prompt side of the stage.
11. The manager has every confidence in the safety of his building and the measures of protection adopted, and

he trusts that the public will accept these assurances and show their confidence by a display of reasonable coolness on an emergency.

## To the Employés.

1. Engagements made at this theatre are subject to the following condition: "That all attendants, scene-shifters, firemen, and other employés shall attend the FIRE and PANIC DRILL, held at this theatre after the evening performance on the last Saturday in each month."
2. Under no circumstances shall the fireman on duty leave the WATCH-ROOM unless relieved by another fireman.
3. All fire-appliances are to be examined, and telephones and electric bells or other means of communication tested, by the chief fireman each day at noon.
4. From the commencement to the end of each performance, one fireman shall remain in attendance on the stage.
5. From the commencement to the end of each performance, one fireman shall patrol the building from signal-point to signal-point, pressing the button to indicate to the fireman on duty in the WATCH-ROOM at what point the patrolling fireman may be found.
6. The line of patrol will be defined by the chief fireman, and on no account shall it be departed from.
7. One push of the button signals the fireman's position in the building to the WATCH-ROOM; two pushes, assistance required; three pushes, actual fire.
8. When three strokes are sounded on the bell, the fireman in the WATCH-ROOM will pull the lever to lower the proscenium curtain, sound an alarm-bell at the prompt, signal to the fire brigade station, and summon the manager.
9. When the alarm-bell is sounded at the prompt, each attendant in charge of an exit will at once open the door, and proceed to act as he may have been instructed at the fire and panic drill.
10. Any attendant, fireman, or other official appearing

without their uniform or badge during the time of the performance will be instantly dismissed.

11. All doors in the theatre will be opened for the admission of the public 30 minutes before the commencement of the performance.
12. Every attendant, fireman, and other employé within the auditorium must be at their respective posts 20 minutes before the doors are opened to the public.
13. The chief fireman shall patrol the building, and ascertain that all the attendants, &c., are on duty, before he gives the signal to admit the public.
14. Scene-shifters are not to block up the hydrants, free access to which must always be maintained.
15. Copies of the Lord Chamberlain's Regulations and those of other authorities are framed and hung in the WATCH-ROOM and at the prompt. The chief fireman will be held responsible to the management for the strict compliance with all regulations, and for the general effectiveness of the fire-extinguishing appliances.
16. No smoking will be permitted in any part of the theatre, with the exception of those rooms specially set apart for smoking. Attendants are expected to enforce this rule.
17. All materials used in the preparation of scenery are to be coated with an approved anti-ignition solution, and the chief fireman will see that this regulation is carried into effect.
18. The chief fireman is in absolute authority during the time the public are within the building, and all employés are expected to give the quickest possible effect to his instructions.
19. All defects in the appliances or insubordination are to be reported to the management without delay.

# SUGGESTIONS FOR A MODEL SAFETY THEATRE.

(*See Frontispiece.*)

RECENT fire catastrophes in theatres have failed to arouse the Legislature, but they have been productive of innumerable plans and suggestions—practicable and impracticable—for the better construction and arrangement of theatres. Without exception, these would-be constructive reformers have failed to realise that the present method of building theatres is radically opposed to all the conditions conducive to the public safety. The requisite improvement in theatres is not so much an alteration in the internal arrangement as an absolute change in the relative positions of the *building* itself and the *ground-line* or street level. The galleried construction of the auditorium is the only one possible for a dramatic theatre, when it is desired to congregate a large number of persons within a satisfactory distance of the stage. In designing a "safety theatre" attention must be chiefly devoted to perfecting the means of egress without interfering with the present disposition of the auditorium. The plan for a "safety theatre" recently proposed by Mr. Henry Irving cannot be regarded as a successful solution of the problem. Mr. Irving, whilst bringing the entire audience nearer the street level, so far increases the superficial area of the auditorium as to destroy the dramatic adaptability of the theatre. Some portion of the audience is considerably removed from the stage under conditions that preclude the possibility of either hearing or seeing the performance comfortably. When theatres are constructed upon the usual galleried plan it is essential to the public safety that each section of the audience should have *equal* facility of egress. This condition of safety is, of course, impossible of attainment in any theatre having the pit at the street level. Reasonable approach to safety can only be secured by such an arrangement of the building as will bring each section of the audience within the least possible distance of the street level or point of exit. To this end the *ground-line* should be nearly equidistant between the pit and gallery levels. Old-fashioned prejudice demands that the pit should be entered at the street

level, but this arrangement is not conducive to the safety of the general audience. A theatre may be honeycombed with exits at the street level, but if these can only be reached by the precipitate descent of a hundred or more steps, their safety is rather in appearance than reality. All fires and panic catastrophes in places of public entertainment have forcibly demonstrated the dangers attendant on crowds rushing madly *down enclosed staircases;* and the plain fact to be deduced from the terrible experiences of the past is that—granted other conditions are favourable—the safest theatre in the event of a panic would be one in which the public had to rush *up* staircases into the street rather than *down.* HENCE THE GALLERY, AND NOT THE PIT, SHOULD BE ENTERED FROM THE STREET LEVEL. The theatre nearest approaching this desirable consummation is the much-abused Criterion Theatre, London. Here every part of the theatre is below the street level, and a superstructure is raised over the auditorium of which the theatre is but the basement. This latter arrangement is altogether unsatisfactory, as it deprives the building of both light and air, the ventilation being accomplished by mechanical means. Yet, notwithstanding these evident drawbacks, a panic occurring in the Criterion Theatre would, in view of past experiences, be attended with less injury to persons than in any other English theatre. Whilst staircases are permitted in theatres for the public use, such buildings will always contain an element of danger to the audience. It is probable, therefore, that the model theatre of the future will be built without a structural arrangement that has ever been favourable to accidents.

Having an isolated site, it would be practicable to erect a theatre, without a single public staircase. The frontispiece is a perspective sketch of such a theatre. The building is erected within an excavation or moat, leaving an open area all round the theatre 25 feet wide from the external walls of the building to the boundary walls of the site. By this arrangement every part of the theatre may be lighted by windows; perfect ventilation secured, together with absolute control in the event of fire. The gallery is entered level with the street, at each side of the auditorium, by means of bridges spanning the moat. These bridges, together with the inclined terraces giving access to the other sections of the auditorium, are all 10 feet wide, and are connected at each level by means of an internal corridor of equal width. The internal

corridors are arranged immediately behind each section of seating, and give direct access to the external terraces. These inclined terraces would be more conducive to safety if left uncovered, as shown in the frontispiece, but could be protected from the weather by an ornamental iron and glass cover, supported on the main walls of the building and the boundary walls of the site. Where the exigencies of the site would permit, the terraces could be made of sufficient width to admit of carriage traffic, in which case they would return round the end of the building, and so permit vehicles to pass up to the street on the opposite side. The frontispiece shows a building erected upon a level site, but with a sloping site the arrangement would be simpler and less expensive.

Inclined terraces, as here suggested, could, of course, be adapted to buildings erected on the surface level, but the dangers arising from panic-stricken crowds rushing wildly *down* such terraces would be only one degree removed from those attendant on the precipitate descent of enclosed staircases. As the proposed arrangement dispenses with internal corridors and *enclosed staircases*, the public would not be subjected to the risks usually associated with these contrivances, the nature of which recent calamities have provided painful evidence. In the event of fire or panic the audience would pass out from each section of the auditorium direct into the open air, when, it is reasonable to assume, their composure and self-possession would return.

The two towers shown in the sketch are intended to carry tanks for the storage of the supplementary water supply for fire-extinguishing purposes. Within these towers would also be constructed the "pass staircases," for the use of the patrolling firemen, communicating with each section of the auditorium, the WATCH-ROOM, and the roofs.

The ventilator over the stage would be made to slide, when desired, simultaneously with the lowering of the iron proscenium curtain, so that in the event of a fire occurring on the stage an opening could be immediately exposed in the stage roof, twelve feet or more square.

The lighting of the moat and external terraces would be independent of the theatre illumination, so that accidents occurring upon the stage or within the auditorium would in no manner affect the means of egress and escape.

The plan shown on the frontispiece is merely in block, and

represents a *self-contained* theatre, to be erected upon an isolated site about 240 feet by 120 feet. The building itself would be 190 feet long by 70 feet wide, with an open area all round 25 feet wide; the saloons 25 feet wide, and the corridors 10 feet wide; auditorium, 75 feet by 70 feet; stage, 70 feet by 40 feet; the workshop and dressing-room blocks, each 70 feet by 25 feet.

The lower tiers would be similar in arrangement to the gallery plan, subject to elaboration of detail and the necessary structural deviations. The foregoing dimensions are not arbitrary, and could be reduced or modified to meet the exigencies of various sites; *e.g.*, the dressing-room block could be entered direct from the street, without the intervening moat, in which case all the rooms would be lighted from the sides. The floor of the moat would be level with the stalls, and escape doors provided from this section and the pit. At the stage end of the moat inclined terraces would be constructed as a means of escape from the moat, also for the conveyance of scenery, properties, animals, &c., to the stage.

Hitherto plans for new theatres have invariably been prepared to suit the sites. If the safety of the public is to be duly considered, the reverse of this operation will have to influence the theatre-builder in the future. *A site should be secured to suit the plan.*

Another and very important advantage to be gained by erecting the "safety theatre" within a moat is the great reduction in the height of the elevation above the street, when a comparatively low pressure of water would suffice to command the entire structure. This advantage cannot be over-estimated. A model theatre should be *self-contained* in every respect. Not only should provision be made for carrying on all those operations incidental to the business of a theatre, but the fire-extinguishing appliances, together with the life and property-saving organisations, should be independent of external aid.

This, however, is not possible whilst theatres are erected having the pit level with the street. Very few theatres have a serviceable water pressure at the gallery level or at the upper parts of the stage. Owing to the great height of some of these buildings, a fire occurring at the highest points could only be successfully extinguished by a steam fire-engine. This is a matter of primary importance, having regard to the safety of a theatre. It has been stated, on good authority, that for the purposes of fire-extinguish-

ment the London water supply can only be considered as partially satisfactory.

"It is furnished by eight companies—the Lambeth, giving a ruling pressure of 115 feet head; the Kent, 90 to 115 feet; the New River and Chelsea, from 70 to 80 feet; the Grand Junction and Southwark and Vauxhall, 60 to 70 feet; the West Middlesex, 60 feet; and the East London, 35 to 45 feet. It is obvious, therefore, that in London, at all events, steam fire-engines are indispensable, unless the water companies could give much better pressures than these figures indicate. Even the best (115 feet), with a couple of hundred feet of hose, would not throw 150 gallons of water per minute to a greater height than 40 or 45 feet. In order to deliver a stream to a height of only 60 feet through 200 feet of hose at the rate of 150 gallons per minute, it would be necessary, owing to friction in the pipes, to have a head at the reservoir or pumping-station of from 207 to 350 feet. A pressure of 100 feet head at the hydrant, if 200 feet of hose were attached and 150 gallons were delivered per minute, would give only about 50 feet at the branch-pipe, and this would throw a stream not more than from 30 feet to 35 feet high. Yet this pressure can be attained in only a few parts of the Metropolis."

At the time the experiments were made, with the object of testing the capabilities of the several Metropolitan water supplies, for the purposes of fire extinguishment, it was demonstrated by Sir Joseph Bazalgette and his colleagues that the London water supply could not be so much improved as to render it possible to dispense with steam fire-engines.

These facts show the necessity for erecting theatres with a low elevation above the street, and the advantages of this method are further demonstrated by reference to the Criterion Theatre, where the water pressure at the *gallery level* is only equalled by four London theatres at the *pit level*.

No doubt many provincial towns are less favourably circumstanced than the Metropolis, whilst in some the water pressure available for fire-extinguishment is practically *nil*.

The real necessity for having efficient fire appliances and a serviceable pressure of water in all buildings used for public assembly was painfully demonstrated at the Exeter Theatre fire, where, according to Captain Shaw's report, "there was no provision made for dealing with an outbreak of fire in the flies, which was

the very part where the greatest danger necessarily existed." It would be charitable to assume that this omission resulted from an inadequate water supply. Such an assumption, however, is incompatible with Captain Shaw's observations on the construction of the theatre, the whole tenure of which precludes the possibility of attempting to palliate the gross negligence and disregard for the public safety evinced by those who were both morally and legally responsible for the deficient constructive arrangements of the building. Legislation with respect to theatres is most desirable. Not alone should a bill be introduced, dealing with Metropolitan theatres, but adequate protection should be accorded the provincial playgoer, whose safety should no longer be at the mercy of incompetent magistrates, parsimonious owners, or architectural specialists.

One of the first and most important requirements is the compulsory provision of an adequate water supply. Where the town mains do not supply the requisite pressure for fire extinguishing purposes it should be compulsory for the municipal or other authority to erect water-towers of sufficient height to provide the desired pressure, and no theatre should be licensed where the internal fire appliances are insufficient to command the entire structure. In towns where there are several places of public entertainment water towers would be erected by companies or private capitalists. Such towers would be as cheap for the theatre manager as the present system, whilst far more effectual. These towers could be further made available for the supply of hydraulic power, which could be used for various purposes. In theatres the power would be available for working the fire-curtains and scenery. Its adoption for the latter purpose would revolutionise the present method of manipulating stage machinery, by dispensing to a great extent with manual labour, and so considerably reducing the working cost of the stage. A water-tower built in the neighbourhood of the Strand, having the supply connected with all the theatres in the neighbourhood, would make them absolutely independent of the Metropolitan Fire Brigade, whilst placing at the command of managers a power the possibilities of which are such as to excite the imagination.

It has been suggested, with some show of reason, that all theatres in the future should be erected in conformity with a plan prepared and sanctioned by the Government, so that persons visiting theatres in any part of the country would be already familiar

with the means of egress and the general arrangements of the buildings.

Whilst prescribing one uniform arrangement of plan, no restrictions would be necessary with respect to the architectural or decorative treatment of the buildings.

Whatever plan may ultimately be adopted in the construction of "safety theatres," it should be evident to the meanest capacity that—whether inclined terraces or staircases are adopted as the means of egress—any arrangement that compels the public in a panic to *ascend* out of the theatre reduces the risk of accident to a minimum, and makes safety doubly secure.

The following references to the plan shown on the frontispiece will assist in explaining the general arrangements of the proposed safety theatre :—

A.A. Descents to dress circle.
B.B. Descents to upper boxes.
C.C. Descents to pit.
D.D. Level entrances to gallery.
E. Entrance to dressing-rooms, stage, &c.
F. Foyer or saloon.
G.G. Retiring-rooms.
H.H. Queue arrangement for ingress.
I. Corridor, 10 feet wide.
J. Auditorium.
K.K. Side passage to private boxes.
L. Stage.
M.N. Workshops, property stores, &c.
O.P. Male and female dressing-rooms.
Q. Dressing-room staircase.
R.R. Level entrances to workshops, property stores, &c.
S.S.S. Moat or open area.
T.T. Covered places for servants or offices for the sale of tickets during the daytime.
U.U. Cupboards for wraps, ventilating shafts, &c.
V.V.V. Street pavement.

# APPENDIX.

## THE METROPOLITAN BOARD OF WORKS REGULATIONS.

REGULATIONS *made by the Metropolitan Board of Works, under the Metropolis Management and Building Acts Amendment Act, 1878, at a Meeting held at the Offices of the Board, Spring Gardens, on Friday, the 2nd day of May, 1879, under the Provisions of the above-mentioned Act.*

I. THESE regulations shall apply to all theatres, houses, or places of public resort within the Metropolis, to be kept open for the public performance of stage plays, and to all houses, rooms, or other places of public resort within the Metropolis, containing a superficial area for the accommodation of the public of not less than 500 square feet, to be opened or kept open for public dancing, music, or other public entertainment of the like kind, under the authority of letters patent from Her Majesty the Queen, her heirs or successors, or of licences by the Lord Chamberlain of Her Majesty's Household, or by any Justices of the Peace, or by any Court of Quarter Sessions which may be granted for the first time after the 22nd day of July, 1878.

II. Every person who, for the first time after the making of these regulations, may be either desirous of obtaining authority to open any house or other place of public resort, within the Metropolis, for the public performance of stage plays, or to open any house, room, or other place of public resort, within the Metropolis, containing a superficial area for the accommodation of the public of not less than 500 square feet for public dancing, music, or other public entertainment of the like kind, shall give notice of such desire to the Metropolitan Board of Works. The notice must contain a statement as to the nature of the interest of such person in the premises so proposed to be opened, and be accompanied by plans, elevations, and sections of such house, room, or place of

public resort, or of the premises of which such house, room, or place of public resort may form part, drawn to a scale of not less than $\frac{1}{8}$th of an inch to a foot, and by a block plan showing its position in relation to the premises adjacent, drawn to a scale of not less than 1 inch to 20 feet, and in the case of new buildings, or of buildings to be adapted as a place of public resort, must be also accompanied by a specification of the works to be executed, describing the materials to be employed and the mode of construction to be adopted, together with such other particulars as may be necessary to enable the Board and its officers to judge whether the requirements of these regulations will, when the building has been completed, have been complied with. The notice must be also accompanied by a detailed statement of the respective numbers of persons proposed to be accommodated in the various portions of such house, room, or place of public resort, and of the area to be assigned to each person, which shall not be less than 1 foot 8 inches by 1 foot 6 inches in the gallery, nor less than 2 feet 4 inches by 1 foot 8 inches in the other parts of the house, room, or other place of public resort.

III. Every such house, room, or place of public resort shall be enclosed with external walls of brick or stone, or partly of brick and partly of stone. The thickness of such walls shall not be less than the thickness prescribed by the Metropolitan Building Act, 1855, for walls of similar height and length in buildings of the warehouse class.

IV. In any house or other place of public resort, for the public performance of stage plays, or where a proscenium shall be erected, the proscenium wall shall be of brick, not less than 13 inches in thickness, and shall be carried up to a height of 3 feet above the roof, and be carried down below the stage, to the level of the foundation of the external walls. No openings shall be formed in the proscenium wall, with the exception of a doorway into the orchestra, and one doorway on each side of the stage for communication with the auditorium. These doorways shall not be more than 3 feet 6 inches wide, and shall be closed with iron doors, fixed without woodwork. The decorations round the proscenium shall be constructed of fire-resisting materials.

V. The staircases and the floors of the passages, lobbies, corridors, and landings shall be of fire-resisting materials. Every staircase for the use of the audience shall be supported and

enclosed by brick walls. The treads of each flight of stairs shall be of uniform width. No staircase, internal corridor, or passage-way, for the use of the audience, shall be less than 4 feet 6 inches wide. Every staircase, corridor, or passage-way for the use of the audience, and which communicates with any portion of the house intended for the accommodation of a larger number of the audience than 400, shall be increased in width by 6 inches for every additional 100 persons, until a maximum width of 9 feet be obtained. Provided always that in every case where the staircases are 6 feet wide and upwards a dividing hand-rail shall be provided. A clear passage or gangway, of not less than 3 feet wide, shall be reserved round every part appropriated to the audience, except that next the proscenium or place of performance.

VI. All ironwork used in construction shall be protected against the action of fire in such manner as may be required by the Board.

VII. In all cases where a portion of the audience is to be accommodated over or at a higher level than others of the audience, a separate means of exit, of the width above prescribed for staircases, internal corridors, or passage-ways, and communicating directly with the street, shall be provided from each floor or level. Separate tiers of boxes shall for this purpose be reckoned together, as forming one floor or level. One additional exit, at the least, communicating with the different levels, and opening directly into the street, must also be provided.

VIII. All doors and barriers shall be made to open outwards.

IX. In theatres and places where the auditorium and stage shall be warmed artificially, hot-water only, and that at low pressure, shall be used, and the warming apparatus shall be placed in a position to be approved by the Board.

X. All openings for ventilation shall be shown on the plans and properly described in the specifications. The openings shall be made in such places and in such manner as may be approved by the Board.

XI. No workshop, painting-room, or dressing-room shall be formed or constructed over the auditorium or in the space under the same.

XII. No scene-dock, property-room, or store-room shall be permitted within any house, room, or other place of public resort, unless such scene-dock, property-room, or store-room be separated

from the house, room, or other place of public resort by brick and fire-proof construction.

XIII. In any case where there are not fire mains on constant supply there shall be provided on the top of the proscenium wall, or at some other place to be approved by the Board, two cisterns, each capable of containing at least 250 gallons of water for every 100 persons of the audience to be accommodated in the building. Fire mains shall be connected with these cisterns, and extend round the whole circuit of the building, and be fitted with hydrants in such places and manner as may be approved by the Board.

XIV. All gas-pipes shall be made of iron or brass. No white-metal pipes shall be used in any part of the building.

XV. In cases in which a house, room, or other place of public resort forms a part only of a building, such house, room, or other place of public resort shall be separated from the other parts of the building by proper party walls or party structures.

XVI. Notice shall be given to the Board of any intended addition to or structural alteration of any house, room, or other place of public resort in respect of which the Board may have granted a certificate to the effect that such house, room, or other place of public resort was on its original completion in accordance with the foregoing regulations, or otherwise in compliance with the said Act, and the conditions required by the Board applicable thereto. Such notice shall be accompanied by plans, elevations, and sections showing such additions and alterations, and also by a specification of the works to be executed in the same manner as in the case of a new building to be certified for the first time by the Board ; and the Board will, if necessary, cause a fresh survey of the building to be made.

XVII. Inasmuch as by section 12 of the said Act the Board may from time to time, in any special case, dispense with or modify its regulations, all applications for dispensation or modification must be in writing, addressed to the Board, and contain a statement of the facts of the particular case, and the reasons why it is desired to modify or dispense with these regulations as applicable thereto.

# THE LORD CHAMBERLAIN'S RULES AND REGULATIONS FOR THEATRES WITHIN HIS JURISDICTION.

1. ALL doors and barriers to open outwards, or to be fixed back, during the time when the public are within the theatre.

2. All gangways, passages, and staircases intended for the exit of the audience to be kept entirely free from chairs or any other obstructions, whether permanent or temporary.

3. An ample water supply, with hose and pipes, to be available to all parts of the house, where possible on the high-pressure main.

4. All fixed and ordinary gas-burners to be furnished with efficient guards. Movable and occasional lights to be, where possible, protected in the same manner, or put under charge of persons responsible for lighting, watching, and extinguishing them. A separate and independent supply of light for the stage and auditory. No white-metal gas-pipes to be used in the building.

5. The footlights or floats to be protected by a wire guard. The first ground-line to be always without gas and unconnected with gas, whether at the wings or elsewhere. Sufficient space to be left between each ground-line, so as to lessen risk from accident to all persons standing or moving among such lines.

6. The rows or lines of gas-burners at wings to commence four feet at least from the level of the stage.

7. Wet blankets or rugs, with filled buckets or water-pots, to be always kept in the wings, and attention to be directed to them by placards legibly printed or painted and fixed near them. As in Rule 4, some person to be responsible for keeping the blankets, buckets, &c., ready for immediate use.

8. Hatchets, hooks, or other means to cut down hanging scenery in case of fire, to be always in readiness.*

* The Committee of the House of Commons, in their Report on Fires in Theatres in 1877, recommend, "With respect to the daily management of the theatre, naked lights should be protected; inflammable materials should not be allowed to be placed where they are likely to catch fire; the hose and other apparatus should be maintained in good order; the passages should be kept clear, and a plan settled beforehand of what should be done in the case of a fire or panic, each of the employés being instructed as to the place he is to take and the duties he is to perform, and all being occasionally drilled together for the purpose."

9. The regulations as to fire to be always posted in some conspicuous place, so that all persons belonging to the theatre may be acquainted with their contents. A report of any fire or alarm of fire, however slight, to be at once sent to the Lord Chamberlain's office.

10. Counter weights, where possible, to be carried to the walls of the building and cased in. The ropes attached to them to be constantly tested.

11. An annual inspection is made of all theatres. It is expected that all alterations suggested for the safety and convenience of the public will be carried out before the issue of the annual licence.

12. No structural alterations to be made in the theatre without the sanction of the Metropolitan Board of Works. Plans of such alterations to be sent to the Lord Chamberlain's office.

13. A copy of every new piece, or alterations of old pieces intended to be produced, to be forwarded for licence to the Examiner of Plays seven clear days before such intended production. No alteration of the text when licensed for representation to be permitted without sanction.

14. Copies of all playbills to be sent to the Lord Chamberlain's office every Monday and whenever a change of performance is announced.

15. Notice of the change of title of a piece to be given to the Examiner of Plays.

16. The name and private address of the actual and responsible manager to be printed in legible type at the head of each bill.

17. Admission to be given at all times to authorised officers of the Lord Chamberlain's department and of the police.

18. No profanity or impropriety of language to be permitted on the stage.

19. No indecency of dress, dance, or gesture to be permitted on the stage.

20. No offensive personalities or representations of living persons to be permitted on the stage, nor anything calculated to produce riot or breach of the peace.

21. No exhibition of wild beasts or dangerous performances to be permitted on the stage. No women or children to be hung from the flies, nor fixed in positions from which they cannot release themselves.

22. No masquerade or public ball to be permitted in the theatre.

23. No encouragement to be given to improper characters to assemble or to ply their calling in the theatre.

24. Refreshments to be sold in the theatre only during the hours of performance, only to the audience and company engaged in the house, and only in positions which do not interfere with the convenience and safety of the audience.

25. No smoking to be permitted in the auditorium.

26. Theatre licences are granted for one year, from the 29th September. Licences are granted also for shorter periods, but all licences cease on the day above mentioned.

27. No public entertainment to be given in the theatre on the days excluded from the licence.

28. Applications for licences, with the names and addresses of the actual and responsible manager and of his two proposed sureties, who must be resident householders and ratepayers, must be forwarded to the Lord Chamberlain's office seven clear days before the day for which the licence is required.

29. Theatre licences are granted, after consultation with the Metropolitan Board of Works, so far as the structural condition of the theatres is concerned, only for buildings in which the above regulations can be carried out, and on the express condition that these and every other reasonable and practicable precaution against fire or the dangers arising therefrom are adopted.

30. The manager is held solely and entirely responsible for the carrying out of the above regulations, for the management of his theatre before and behind the curtain, and for the safety of the public and the members of his company.

31. All exits from the theatre must be plainly indicated by placards, and kept always available for the use of the audience.

32. The service of light for the auditorium and entrance passages must be separate from that for the stage.

LATHOM,

*Lord Chamberlain.*

TABLE OF THE PRINCIPAL DIMENSIONS,

| Name. | Curtain to Back Wall of Pit. | Curtain to Front of 1st Circle. | Curtain to Front of 2nd Circle. | Curtain to Front of 3rd Circle. | Height from Pit Floor to Ceiling. |
|---|---|---|---|---|---|
| | ft. in. | ft. in. | ft. in. | ft. in. | ft. in. |
| Adelphi ... ... | 74 0 | 39 6 | 45 0 | 44 0 | 42 6 |
| Alhambra ... ... | 82 0 | 60 0 | 60 0 | 68 0 | 80 0 |
| Astley's ... ... | 91 6 | 56 0 | 60 0 | ... | 46 0 |
| Avenue ... ... | 63 9 | 41 9 | 45 9 | ... | 40 0 |
| Britannia ... ... | 70 0 | 51 0 | 51 0 | 51 0 | 47 0 |
| Comedy ... ... | 62 0 | 30 6 | 34 0 | 37 0 | 45 0 |
| Covent Garden ... | 80 0 | 80 0 | 80 0 | 80 0 | 64 0 |
| Criterion ... ... | 50 0 | 31 6 | 38 0 | ... | 26 0 |
| Drury Lane ... | 74 0 | 60 6 | 60 6 | 68 0 | 55 0 |
| Elephant and Castle | 67 0 | 37 0 | 39 0 | ... | 38 0 |
| Empire ... ... | 84 6 | 57 0 | 57 0 | 67 0 | 60 0 |
| Gaiety ... ... | 53 6 | 36 0 | 45 0 | 47 6 | 52 6 |
| Globe ... ... | 47 6 | 30 9 | 30 9 | ... | 34 0 |
| *Grand ... ... | 76 0 | 38 6 | 41 0 | ... | 44 0 |
| Greenwich... ... | 43 0 | 31 0 | 31 0 | ... | 28 0 |
| Haymarket ... | No Pit | 41 6 | 44 0 | 51 0 | 41 0 |
| Her Majesty's ... | 69 0 | 69 0 | 69 0 | 69 0 | 63 6 |
| Imperial ... ... | 65 0 | 48 0 | 51 0 | ... | 43 0 |
| †Lancaster's ... | 58 4 | 35 0 | 40 8 | 44 6 | 47 0 |
| Lyceum ... ... | 63 0 | 47 0 | 47 0 | 47 0 | 49 0 |
| †Lyric ... ... | 60 9 | 38 0 | 44 9 | 48 3 | 40 6 |
| Marylebone ... | 75 0 | 46 0 | 46 0 | ... | 32 0 |
| Novelty ... ... | 49 6 | 28 6 | 28 6 | 30 6 | 40 0 |
| Olympic ... ... | 59 0 | 41 6 | 41 6 | ... | 33 6 |
| Opera Comique ... | 51 6 | 38 6 | 38 6 | 38 6 | 36 0 |
| Paragon ... ... | 100 0 | 58 0 | ... | ... | 60 0 |
| Pavilion ... ... | 74 0 | 52 0 | 52 0 | ... | 37 0 |
| Prince of Wales's ... | 58 6 | 34 0 | 40 6 | 44 2 | 45 6 |
| Princess's ... ... | 60 10 | 32 0 | 39 0 | 41 6 | 56 0 |
| Royalty ... ... | 50 0 | 28 0 | 34 0 | ... | 36 0 |
| Sadler's Wells ... | 65 0 | 41 0 | 46 0 | ... | 37 0 |
| Savoy ... ... | 51 0 | 34 6 | 43 10 | 48 6 | 48 0 |
| St. James's.. ... | 57 0 | 40 0 | 43 0 | 44 6 | 36 0 |
| Standard ... ... | 75 0 | 57 0 | 59 0 | 63 0 | 55 0 |
| Strand ... ... | 57 0 | 31 6 | 39 0 | ... | 36 0 |
| Stratford, E. ... | 43 9 | 23 9 | 26 6 | ... | 33 0 |
| Surrey ... ... | 69 0 | 56 6 | 56 6 | 56 6 | 50 0 |
| Terry's ... ... | 55 0 | 28 0 | 31 0 | ... | 40 0 |
| Toole's ... ... | 55 0 | 31 9 | 31 9 | ... | 27 0 |
| Variety (Hoxton) ... | 48 0 | 31 6 | 31 6 | ... | 38 6 |
| Vaudeville... ... | 58 9 | 30 6 | 36 6 | ... | 34 0 |

* Destroyed by fire December 29th, 1887. † In course of construction.

SHOWING THE COMPARATIVE SIZES.

| Number of Persons Accommodated | Curtain to Back Wall of Stage. | | Width between Walls of Stage. | | Width of Proscenium Opening. | | Height of Proscenium Opening. | | Height from Stage Floor to Gridiron. | | Depth from Stage Floor to Cellar. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft. | in. | ft. | in. | ft. | in. | ft. | in. | ft. | in. | ft. | in. |
| 2300 | 53 | 0 | 65 | 6 | 34 | 0 | 37 | 0 | 55 | 0 | 12 | 6 |
| 3500 | 42 | 0 | 66 | 0 | 36 | 0 | 40 | 0 | 60 | 0 | 24 | 0 |
| 3000 | 51 | 6 | 96 | 0 | 47 | 0 | 36 | 0 | 43 | 0 | 16 | 0 |
| 1200 | 28 | 6 | 50 | 0 | 26 | 0 | 28 | 9 | 50 | 9 | 16 | 4 |
| 3500 | 58 | 0 | 76 | 0 | 37 | 0 | 38 | 0 | 50 | 0 | 21 | 0 |
| 1185 | 28 | 0 | 49 | 0 | 25 | 0 | 28 | 0 | 43 | 0 | 9 | 0 |
| 3000 | 86 | 0 | 90 | 0 | 44 | 0 | 38 | 0 | 66 | 0 | 21 | 0 |
| 750 | 24 | 0 | 45 | 0 | 22 | 0 | 20 | 0 | 22 | 0 | 8 | 0 |
| 3500 | 79 | 0 | 76 | 0 | 37 | 0 | 41 | 0 | 58 | 0 | 18 | 0 |
| 2600 | 40 | 0 | 68 | 0 | 29 | 0 | 28 | 0 | 47 | 0 | 15 | 0 |
| 3000 | 47 | 0 | 76 | 0 | 37 | 0 | 36 | 6 | 46 | 0 | 20 | 0 |
| 1150 | 41 | 0 | 61 | 6 | 30 | 0 | 29 | 0 | 49 | 0 | 19 | 6 |
| 1100 | 31 | 6 | 66 | 3 | 20 | 9 | 26 | 9 | 42 | 0 | 9 | 0 |
| 3000 | 47 | 6 | 51 | 9 | 30 | 6 | 32 | 0 | 52 | 0 | 18 | 0 |
| 900 | 27 | 0 | 41 | 0 | 20 | 6 | 24 | 0 | 30 | 0 | 8 | 6 |
| 1100 | 41 | 0 | 57 | 6 | 28 | 0 | 24 | 0 | 52 | 0 | 7 | 0 |
| 2444 | 53 | 0 | 95 | 0 | 39 | 0 | 35 | 8 | 65 | 0 | 25 | 0 |
| 1450 | 40 | 6 | 58 | 8 | 30 | 6 | 27 | 0 | 42 | 0 | 12 | 6 |
| 1800 | 45 | 0 | 65 | 0 | 30 | 0 | 27 | 0 | 54 | 0 | 19 | 0 |
| 1850 | 40 | 0 | 72 | 0 | 34 | 0 | 38 | 0 | 46 | 0 | 14 | 0 |
| ... | 41 | 0 | 70 | 0 | 35 | 0 | 27 | 0 | ... | | ... | |
| 1400 | 40 | 0 | 45 | 0 | 22 | 6 | 29 | 0 | 36 | 0 | 8 | 0 |
| 1000 | 23 | 0 | 41 | 6 | 26 | 0 | 25 | 0 | 40 | 0 | 9 | 0 |
| 900 | 31 | 6 | 40 | 0 | 27 | 0 | 29 | 0 | No Gridiron. | | 10 | 0 |
| 1000 | 21 | 6 | 60 | 6 | 32 | 0 | 26 | 0 | 42 | 6 | 10 | 0 |
| 2500 | 64 | 0 | 100 | 0 | 34 | 0 | 34 | 0 | 60 | 0 | 20 | 0 |
| 2200 | 62 | 0 | 64 | 0 | 32 | 0 | 26 | 0 | 42 | 0 | 12 | 0 |
| 1200 | 30 | 0 | 75 | 0 | 30 | 0 | 27 | 0 | 36 | 0 | 20 | 0 |
| 1900 | 40 | 5 | 62 | 3 | 32 | 0 | 33 | 0 | 49 | 0 | 18 | 6 |
| 800 | 27 | 0 | 40 | 0 | 25 | 0 | 24 | 0 | 30 | 0 | 12 | 0 |
| 1800 | 50 | 0 | 48 | 6 | 26 | 0 | 31 | 0 | 50 | 6 | 8 | 6 |
| 1150 | 47 | 6 | 59 | 0 | 30 | 0 | 35 | 0 | 56 | 0 | 15 | 0 |
| 1000 | 55 | 0 | 53 | 0 | 25 | 0 | 28 | 0 | 44 | 0 | 12 | 6 |
| 3300 | 55 | 0 | 60 | 0 | 32 | 0 | 41 | 0 | 69 | 0 | 14 | 0 |
| 1000 | 25 | 0 | 60 | 0 | 26 | 0 | 26 | 0 | 37 | 0 | 20 | 0 |
| 850 | 18 | 0 | 40 | 0 | 23 | 0 | 24 | 0 | 31 | 0 | 8 | 6 |
| 2500 | 60 | 0 | 70 | 0 | 32 | 0 | 38 | 0 | 50 | 0 | 25 | 0 |
| 800 | 26 | 0 | 39 | 0 | 22 | 6 | 26 | 0 | 40 | 0 | 9 | 0 |
| 900 | 20 | 0 | 36 | 0 | 20 | 9 | 20 | 0 | 36 | 0 | 9 | 0 |
| 1000 | 15 | 0 | 34 | 0 | 21 | 0 | 26 | 6 | 30 | 0 | 8 | 0 |
| 1000 | 24 | 0 | 40 | 0 | 21 | 6 | 21 | 6 | 37 | 0 | 8 | 0 |

*The following dimensions of Provincial Theatres have been*

| Name. | Curtain to Back Wall of Pit. | Curtain to Front of 1st Circle. | Curtain to Front of 2nd Circle. | Curtain to Front of 3rd Circle. | Height from Pit Floor to Ceiling. |
|---|---|---|---|---|---|
| | ft. in. | ft. in. | ft. in. | ft. in. | ft. in. |
| Aberdeen (H. M. T.)... | 42 0 | 33 6 | 42 0 | 40 6 | 41 0 |
| Belfast (T. R.) ... | 68 0 | 34 0 | 37 0 | 42 0 | 45 0 |
| Birmingham (T. R.)... | 55 6 | 55 6 | 55 6 | 62 3 | 47 0 |
| „ (Queens) | 68 0 | 42 0 | 44 0 | ... | 42 0 |
| Cambridge (T. R.) ... | 80 0 | 50 0 | ... | ... | ... |
| Cardiff (T. R.) ... | 59 0 | 31 0 | behind 1st Circle. 47 0 | 31 0 | 55 0 |
| Cork (T. and O. H.)... | 65 0 | 40 0 | 50 0 | 50 0 | 50 0 |
| Darlington (T. R.) ... | 55 0 | 30 0 | 39 0 | 42 6 | 37 6 |
| Derby (Grand) ... | 70 6 | 45 0 | 46 0 | ... | 45 0 |
| Edinburgh (Lyceum) | 65 0 | 38 0 | 42 6 | 48 6 | 47 6 |
| Glasgow (Royalty) ... | 56 0 | 30 0 | 30 0 | 40 0 | 50 0 |
| „ (T. R.) ... | 68 6 | 41 3 | 49 3 | 51 0 | 59 0 |
| Gravesend (New) ... | 41 0 | 27 0 | ... | ... | 30 0 |
| Hanley (T. R.) ... | 54 0 | 37 6 | 38 0 | 38 6 | 49 0 |
| Huddersfield (T. R. & O. H.) | 57 0 | 39 0 | 42 0 | 46 0 | 54 0 |
| Ipswich (T. R.) ... | 36 0 | 36 0 | 34 0 | 33 0 | 26 0 |
| Leeds (Grand) ... | 73 0 | 54 0 | 48 0 | 44 0 | 54 6 |
| Leicester (O. H.) ... | 68 0 | 43 0 | 56 0 | 56 0 | 50 0 |
| Northampton (O. H.) | 55 0 | 31 0 | 38 6 | 38 6 | 36 0 |
| Oxford (New Theatre) | 54 0 | 37 0 | 37 0 | ... | 35 0 |
| Runcorn (T. R.) ... | 60 0 | 26 0 | Gallery at the back of Pit. | | 26 0 |
| Sheffield (T. R.) ... | 62 6 | 36 6 | 39 6 | 41 6 | 51 0 |
| South Shields (T. R.) | 52 0 | 34 0 | 36 0 | ... | 56 0 |
| Sunderland (T. R.) ... | 49 0 | 38 0 | 41 0 | ... | 44 0 |
| West Bromwich (T. R.) | 60 0 | 34 8 | 37 8 | ... | 29 0 |
| West Hartlepool (T. R.) | 80 0 | 45 0 | 50 0 | ... | 50 0 |

*kindly forwarded to the Author by the respective Managers :—*

| Number of Persons Accommodated | Curtain to Back Wall of Stage | | Width between Walls of Stage. | | Width of Proscenium Opening. | | Height of Proscenium Opening. | | Height from Stage Floor to Gridiron. | | Depth from Stage Floor to Cellar. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft. | in. | ft. | in. | ft. | in. | ft. | in. | ft. | in. | ft. | in |
| 1750 | 29 | 0 | 54 | 0 | 27 | 0 | 29 | 0 | 38 | 0 | 14 | 0 |
| 2500 | 33 | 0 | 55 | 0 | 28 | 0 | 33 | 0 | 55 | 0 | 12 | 0 |
| 2500 | 68 | 9 | 65 | 0 | 31 | 3 | 33 | 0 | 57 | 0 | 18 | 0 |
| 2500 | 30 | 0 | 63 | 0 | 30 | 0 | 30 | 0 | 62 | 0 | 20 | 0 |
| 800 | 35 | 0 | 40 | 0 | 21 | 0 | 18 | 0 | 25 | 0 | 9 | 0 |
| 2000 | 42 | 0 | 56 | 0 | 24 | 0 | 27 | 0 | 40 | 0 | 16 | 0 |
| 2000 | 40 | 0 | 54 | 6 | 29 | 0 | 40 | 0 | 50 | 0 | 13 | 0 |
| 1850 | 39 | 3 | 49 | 0 | 24 | 0 | 27 | 0 | 43 | 0 | 11 | 6 |
| 2500 | 35 | 0 | 67 | 0 | 30 | 0 | 30 | 0 | 64 | 0 | 23 | 0 |
| 2500 | 44 | 0 | 78 | 0 | 28 | 0 | 33 | 0 | 60 | 0 | 20 | 0 |
| 2000 | 40 | 0 | 56 | 0 | 29 | 0 | 31 | 0 | 47 | 0 | 27 | 0 |
| 3062 | 50 | 0 | 72 | 6 | 30 | 10 | 36 | 0 | 60 | 0 | 20 | 0 |
| 800 | 19 | 0 | 46 | 6 | 23 | 0 | 21 | 0 | 26 | 0 | 9 | 0 |
| ... | 46 | 0 | 88 | 0 | 29 | 0 | 30 | 0 | 45 | 0 | 18 | 6 |
| 1900 | 37 | 0 | 55 | 0 | 27 | 0 | 32 | 0 | 45 | 0 | 20 | 0 |
| 1000 | 26 | 0 | 40 | 0 | 22 | 0 | 16 | 0 | 23 | 0 | 7 | 0 |
| 2600 | 48 | 0 | 72 | 6 | 32 | 6 | 40 | 0 | 62 | 0 | 21 | 0 |
| 3000 | 44 | 0 | 60 | 6 | 34 | 0 | 38 | 0 | 56 | 0 | 21 | 0 |
| 1500 | 35 | 0 | 46 | 0 | 21 | 0 | 29 | 0 | 50 | 0 | 9 | 0 |
| 950 | 30 | 0 | 50 | 0 | 24 | 0 | 24 | 0 | 43 | 0 | 12 | 0 |
| 1500 | 25 | 0 | 50 | 0 | 24 | 0 | 17 | 0 | 20 | 0 | 6 | 0 |
| 2500 | 40 | 6 | 50 | 0 | 26 | 0 | 30 | 0 | 49 | 6 | 9 | 0 |
| 1500 | 40 | 0 | 52 | 0 | 24 | 0 | 36 | 0 | 32 | 0 | 18 | 0 |
| 1900 | 30 | 0 | 60 | 0 | 30 | 0 | 32 | 0 | 52 | 0 | 18 | 0 |
| 1800 | 18 | 0 | 44 | 0 | 18 | 3 | 20 | 0 | 28 | 0 | 16 | 6 |
| 1700 | 26 | 0 | 42 | 0 | 22 | 0 | 26 | 0 | 40 | 0 | 10 | 0 |

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